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Runway Safety: It's **Everybody's** Business

"WE WANT **YOU**
TO PUT THE BRAKES
ON RUNWAY INCURSIONS"

Final Report
July 2001

Runway Safety: It's **Everybody's** Business

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This booklet tell pilots and controllers what they can do to help prevent runway incursions by helping them to avoid situations that induce errors and alerting them to situations as extra vigilance is required. It also provides information on how controllers and pilots can help each other to work more effectively. Chapter topics include: communications, memory, teamwork, and fatigue.

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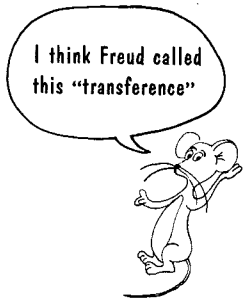
We don't look good until YOU look good. ATC is perceived by pilots in different ways at different airports, but some things are beyond their control.



"Simple airport layouts and simplified procedures translate into perceptions that the controllers are 'the best'. Complex layouts and complex procedures leading to too much to say too rapidly, and congested taxiways and frequencies, translate into perceptions that the controllers are 'the worst'."[1]

OK, so there's not much you can do about your airport layout or the number of aircraft that fly in and out. BUT – your demeanor on the frequency will influence pilot behavior. If you sound friendly and approachable (as opposed to curt, impatient, and too busy for God), pilots will be more likely to ask questions when they are uncertain of their clearance or location on the airport surface. A little patience can go a long way.

About the Authors

Kim Cardosi has a Ph.D. in experimental psychology from Brown University and a private pilot's certificate. She has been conducting studies at the Volpe Center in ATC Human Factors and working with controllers for over 10 years. In addition to being co-editor of *Human Factors in the Design and Evaluation of Air Traffic Control Systems*, Kim has written for *The NATCA Voice* and *Air Line Pilot*. She is currently working on issues concerning runway safety, system integration, and free flight. Kim also serves on the Board of Directors for the Air Traffic Control Association.

Brian J. Fallon is an FAA controller at the New York Tracon and a private pilot. He is also an associate editor for The NATCA Voice "A national grassroots newsletter written by controllers for controllers." As a hobby, Brian likes to draw aviation-oriented cartoons, some of which can be seen in *The NATCA Voice*. Brian has been tackling (and has been tackled by) human factors issues for several years. After collaborating on *Human Factors for Air Traffic Control Specialists: A User's Manual for Your Brain*, it didn't take much coercion to get him to volunteer to collaborate on this publication.

Daniel J. Hannon has a Ph.D. in experimental psychology from Brown University, expertise in color perception and displays, and a natural talent for drawing. In the past, he has worked on display issues in the cockpit and in ATC. He is currently a professor and researcher at the Volpe Center investigating a variety of issues including enhanced vision systems for the tower.

Preface

This booklet tells pilots and controllers what they can do to help prevent runway incursions. It alerts them to situations where extra vigilance is required. It also provides information on how pilots and controllers can help each other work together more effectively. Many examples of pilot and controller errors are included in this work. These incidents are included solely to highlight conditions that can lead even the most skilled professionals into making life-threatening mistakes. It is hoped that by sharing these examples, we can all come to a greater understanding of the roles and responsibilities of pilots and controllers, and the causes and prevention of runway incursions.

This document was sponsored by the Federal Aviation Administration's Office of the Chief Scientific and Technical Advisor for Human Factors (AAR-100). We thank Paul Krois of that office and Larry Cole of the Runway Safety Program Office for their encouragement, support, and guidance. We are also very grateful to the many reviewers who generously shared their time and talents to suggest revisions and provide helpful comments. The following individuals represent the subset of people, whom I particularly imposed upon for technical guidance: Alan Campbell, Carl Calcasola, Brian Fallon, John Lauer, Mack Moore, Terry Shell, and Alan Yost. We also thank Anita Graffeo (EG&G/Battelle) for patiently handling the many revisions and difficult editing tasks and Brad Schneider (Planners Cooperative) for his creative problem solving with the graphics.

METRIC/ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in) = 2.5 centimeters (cm)
1 foot (ft) = 30 centimeters (cm)
1 yard (yd) = 0.9 meter (m)
1 mile (mi) = 1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2) = 6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2) = 0.09 square meter (m^2)
1 square yard (sq yd, yd^2) = 0.8 square meter (m^2)
1 square mile (sq mi, mi^2) = 2.6 square kilometers (km^2)
1 acre = 0.4 hectare (he) = 4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz) = 28 grams (gm)
1 pound (lb) = 0.45 kilogram (kg)
1 short ton = 2,000 pounds (lb) = 0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp) = 5 milliliters (ml)
1 tablespoon (tbsp) = 15 milliliters (ml)
1 fluid ounce (fl oz) = 30 milliliters (ml)
1 cup (c) = 0.24 liter (l)
1 pint (pt) = 0.47 liter (l)
1 quart (qt) = 0.96 liter (l)
1 gallon (gal) = 3.8 liters (l)
1 cubic foot (cu ft, ft^3) = 0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3) = 0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

[(x-32)(5/9)] °F = y °C

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm) = 0.04 inch (in)
1 centimeter (cm) = 0.4 inch (in)
1 meter (m) = 3.3 feet (ft)
1 meter (m) = 1.1 yards (yd)
1 kilometer (km) = 0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2) = 0.16 square inch (sq in, in^2)
1 square meter (m^2) = 1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2) = 0.4 square mile (sq mi, mi^2)
10,000 square meters (m^2) = 1 hectare (ha) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gm) = 0.036 ounce (oz)
1 kilogram (kg) = 2.2 pounds (lb)
1 tonne (t) = 1,000 kilograms (kg) = 1.1 short tons

VOLUME (APPROXIMATE)

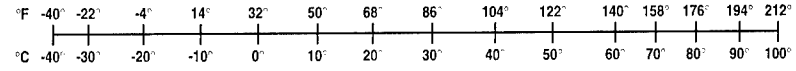
1 milliliter (ml) = 0.03 fluid ounce (fl oz)
1 liter (l) = 2.1 pints (pt)
1 liter (l) = 1.06 quarts (qt)
1 liter (l) = 0.26 gallon (gal)
1 cubic meter (m^3) = 36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3) = 1.3 cubic yards (cu yd, yd^3)

TEMPERATURE (EXACT)

[(9/5) y + 32] °C = x °F

QUICK INCH - CENTIMETER LENGTH CONVERSION

QUICK FAHRENHEIT- CELSIUS TEMPERATURE CONVERSION



For more exact and or other conversion factors, see NIST Miscellaneous Publication 286, Units of Weights and Measures. Price $2.50 SD Catalog No. C13 10286

Updated 6/17/98

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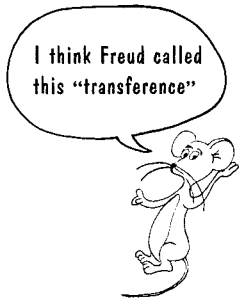
Controllers are perceived by pilots in different ways at different airports, but some things just aren't fair.

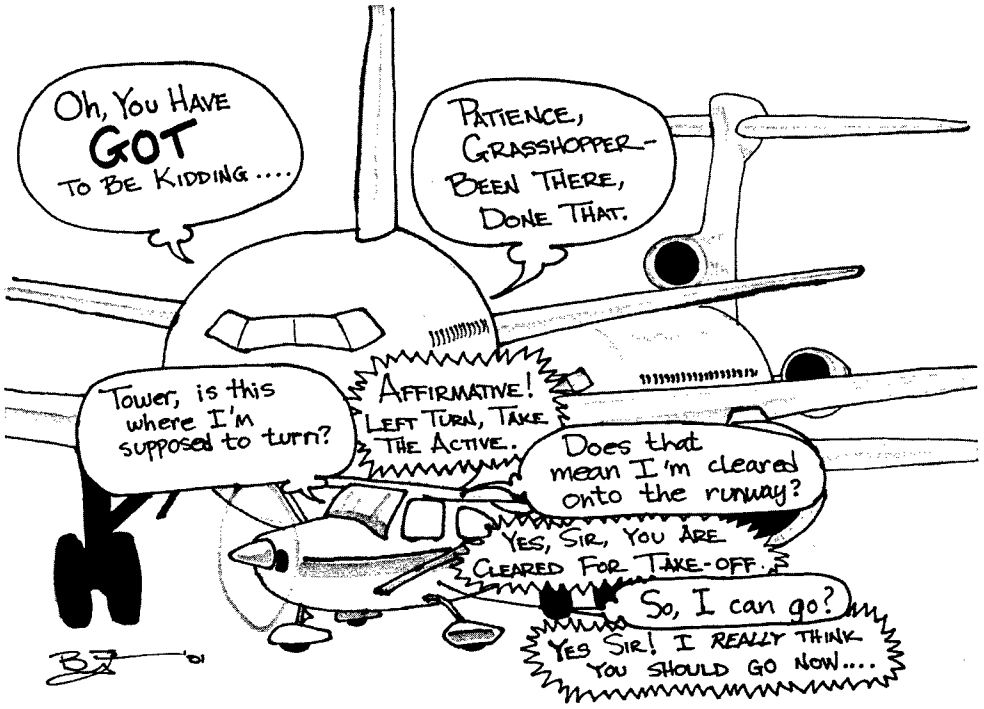
> "Simple airport layouts and simplified procedures translate into perceptions that the controllers are "the best." Complex layouts and complex procedures leading to too much to say too rapidly, and to congested taxiways and frequencies, translate into perceptions that the controllers are "the worst." [1]



Back-to-basics: THE CNS OF SURFACE OPERATIONS

CNS – in psychology it stands for Central Nervous System.

In aviation it stands for Communication, Navigation and Surveillance. Either way, it's at the core of what we do.



Chapter 1

Operational Errors in the Tower: What Causes Them and How to Avoid Them

Recipe for an operational error:

Take one controller. Add stresses of everyday life, incorporate limitations of human memory. Add one or more of the following: inadequate communication between ground and local position, absence of a person providing watch supervision (i.e., supervisor, or controller-in-charge, not working a control position), an inadequate relief briefing, a readback error, an aircraft holding on the end of the runway for two or more minutes. This is the stuff operational errors are made of. Such a mixture can result in operational errors or deviations in periods of low, moderate or heavy workload, but the controller may be particularly vulnerable in the first 10 minutes of assuming the position. Add an errant vehicle, a lost pilot, a wrong turn, a missed "hold short." This is the stuff runway incursions are made of. Add any restrictions to visibility and the mix becomes even more dangerous. Bad weather makes things more difficult for pilots and controllers.

Important note: A well-rested, highly motivated, super controller may be substituted for the average human for the same results; there are some situations that make human error almost inevitable. This booklet will help you to recognize and avoid these situations.

A recent study of tower operational errors and deviations showed that the most common factor contributing to these incidents was that the controller forgot about something.[2] The second most common factor was communication error between the controller and a pilot. The third most commonly identified factor was inadequate coordination among controllers in the tower. There is nothing we can do to eliminate memory lapses or communication errors; however, this booklet contains many suggestions for helping to reduce the chances of operational errors. It also provides tips on how pilots and controllers can work together more efficiently.

What's the number one contributing factor to a tower controllers' operational errors?

Chapter 2

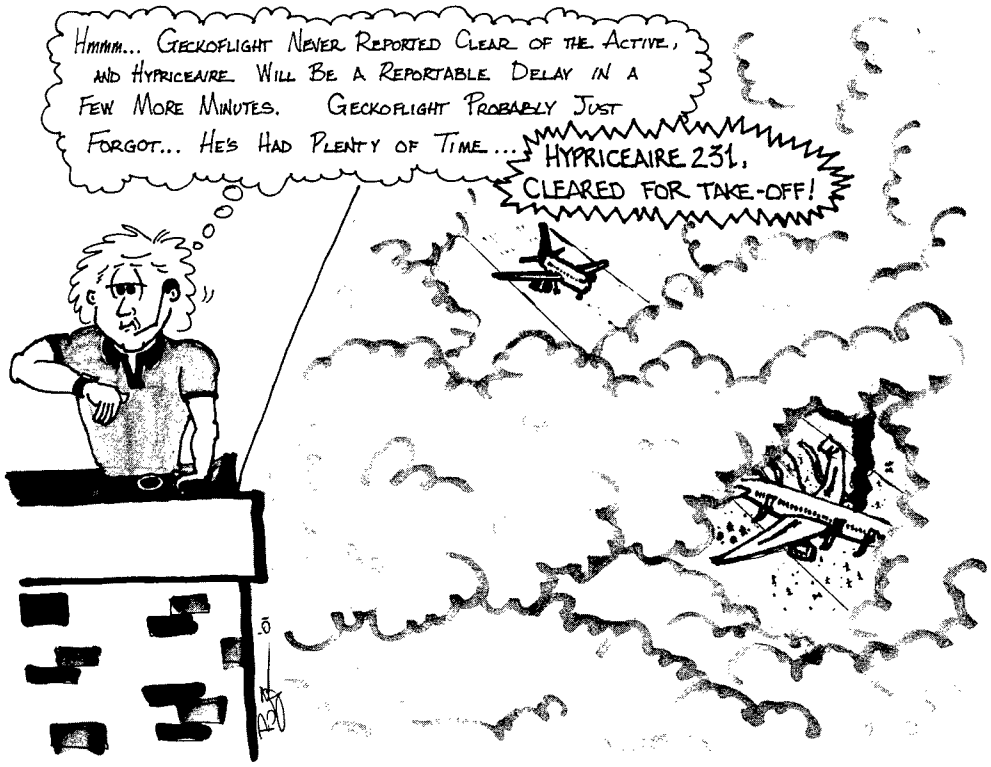
How to Make the Most of the Memory You Have

The most common identifiable factor, contributing to 27% of the operational errors and deviations examined, was the controller "forgetting" something[2]. In 15% of the errors, the controller forgot about an aircraft (e.g., holding in position or on approach), in 5%, the controller forgot that a runway was closed and in 3% the controller forgot about a vehicle on the runway. (The remaining 4% involved the controller forgetting something else, such as a local procedure.)

Don't plan on leaving an aircraft holding in position (at the departure end or at the intersection of the runway) for more than a minute – it's too easy to get distracted and forget about it.

Never assume that a runway is clear (or that the clearance that you issued was followed). Keep up your scan and check.

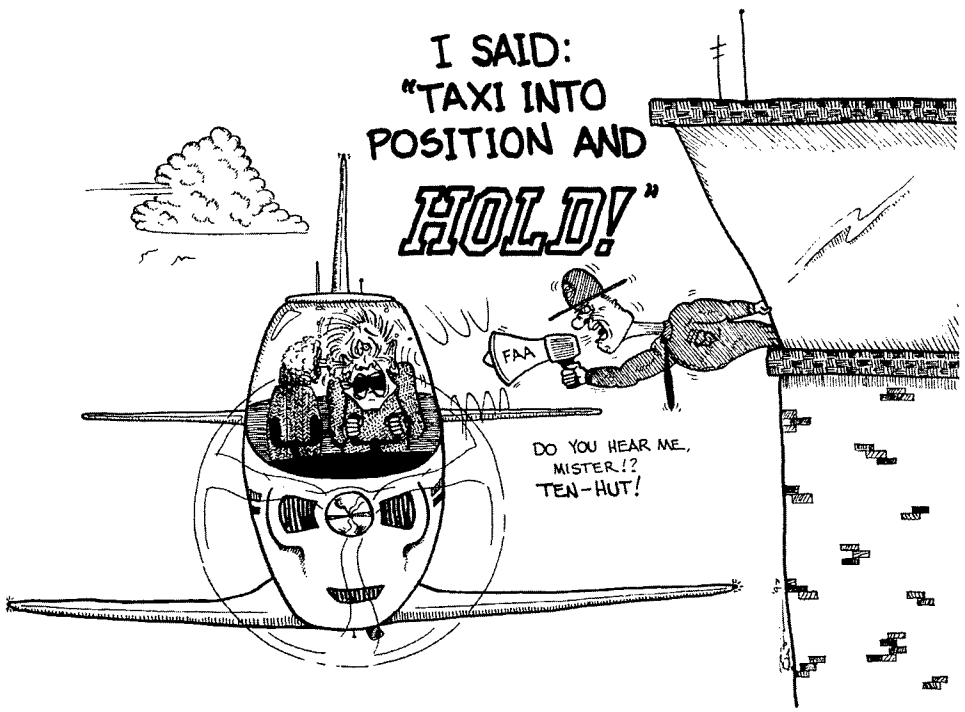
Some facilities use strip holders painted in fluorescent colors with strips declaring things like "Runway xx closed" or "vehicles on the runway." Other facilities put similar reminders over the wind indicators for the runway. What home-made innovation do you use at your facility that might help other controllers prevent runway incursions or reduce workload? We'd like to know. Send your ideas to Kim Cardosi [cardosi@volpe.dot.gov or DTS-79, Volpe Center, 55 Broadway, Cambridge, MA 02142].



Human memory is unreliable and needs all the help it can get. Observe the memory-joggers used by other controllers and use what works for you.

"Working" with specific information will help you to remember it. Even the simple acts of repeating the information or writing it down (where you can refer to it later) will help you to remember it. However, when it comes to strip marking or other notations, make sure you only write changes to a clearance AFTER you've issued or observed it – otherwise, you risk assuming that a pilot will comply with an instruction that you only thought you issued (as described in the following excerpt from an operational error report):

> "The local controller intended to turn the aircraft to a 070 heading prior to shipping the aircraft to departure, but failed to do so. The controller had written a heading of 070 on the flight progress strip and because he does not normally write the heading until it is transmitted, he believed that the heading had been issued." As the aircraft continued on its original heading, loss of separation occurred with another aircraft.

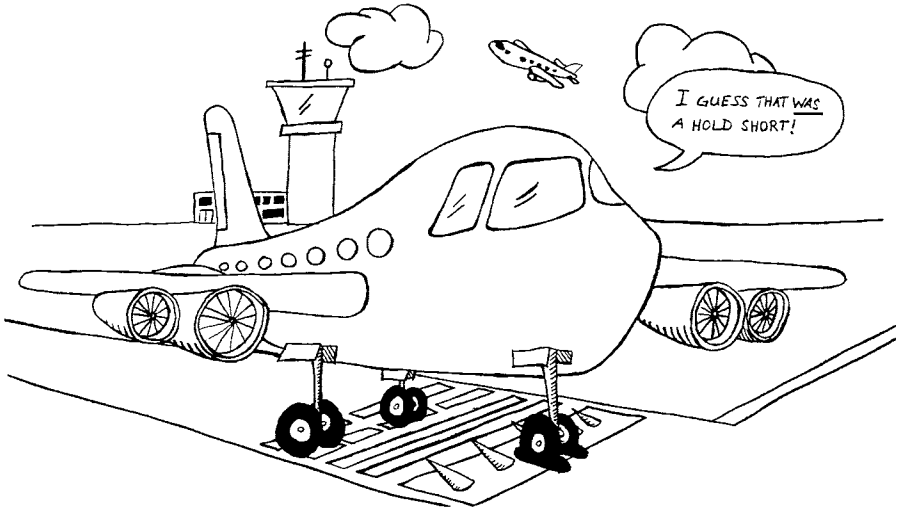


Chapter 3

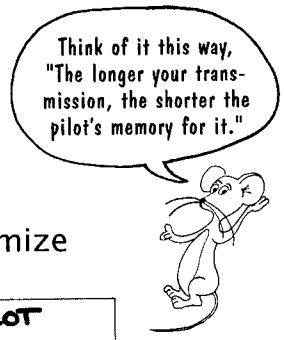
Controller - Pilot Communications: How to Help Pilots Hear What You want Them to Hear

Problems of the operational error sort are rarely simple, they are often due to a combination of factors or a "snowballing" effect. Communication – or miscommunication – is often part of the equation.

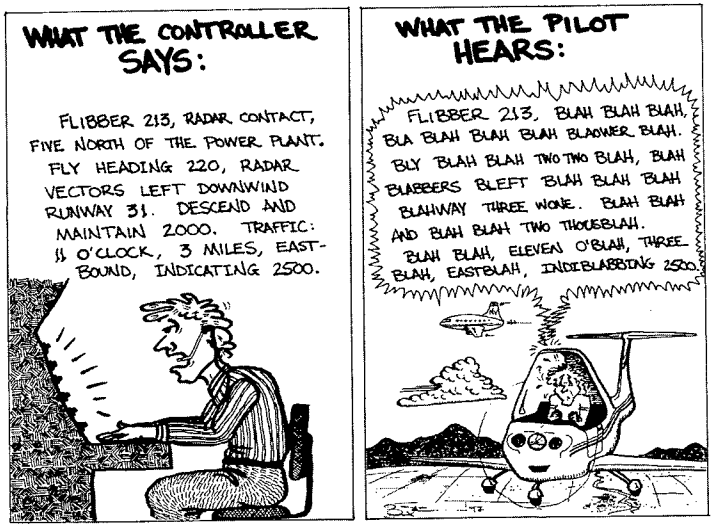
The controller instructed a foreign pilot to taxi via Juliet and "hold short of 22R." The pilot readback (with a heavy accent) "OK, straight ahead on Juliet and no hold short on 22R." The use of non-standard phraseology – "no hold short" rather than "cross runway" - was an unwitting "set up" for the controller. Hearing what he expected to hear – "hold short" – he didn't hear the "no" and expected the pilot to hold. To further complicate the situation, although visibility was 1/4 mile, the intersection of Runway 22R and Juliet was not visible from the tower. The errant aircraft crossed the runway as another aircraft was departing on the same runway.



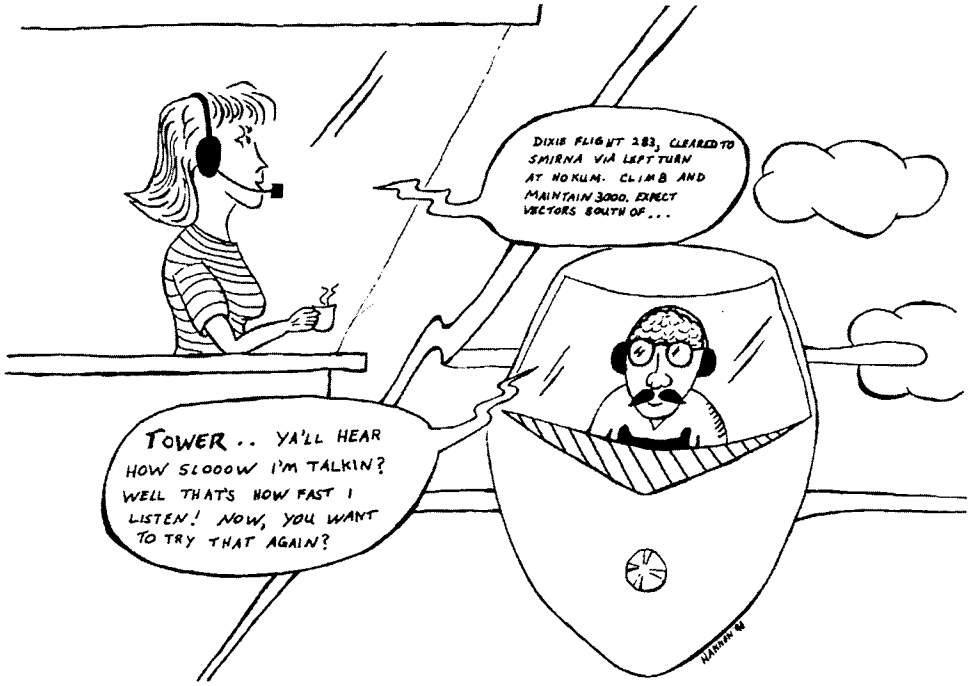
Communication errors between pilots and controllers was found to be the second most common contributing factor in - and occurring in almost one out of five - tower operational errors.[2] While it is safe to say that there will be controller-pilot communication errors for as long as there are controller-pilot communications, there are things you can do to help minimize these errors.

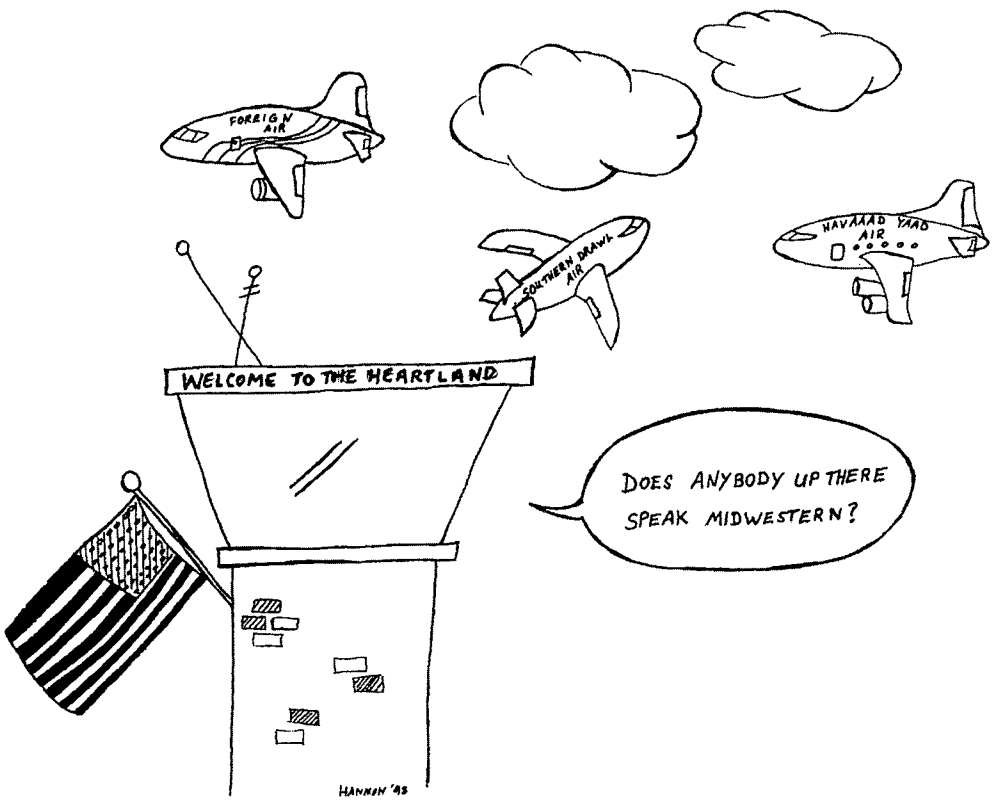


Believe it or not, there is a lot you can do to help pilots hear and remember the clearance you issued. First, **Keep it simple**. There are fewer readback errors and requests for repeats with short and simple transmissions.[3,4] With fewer readback errors, you have fewer hearback errors.



Speaking quickly may seem like a timesaver, but it can backfire. In one simulation study, the rate of pilot readback errors doubled when the same controller issued the same complex clearances in a moderately faster speaking voice.[5]

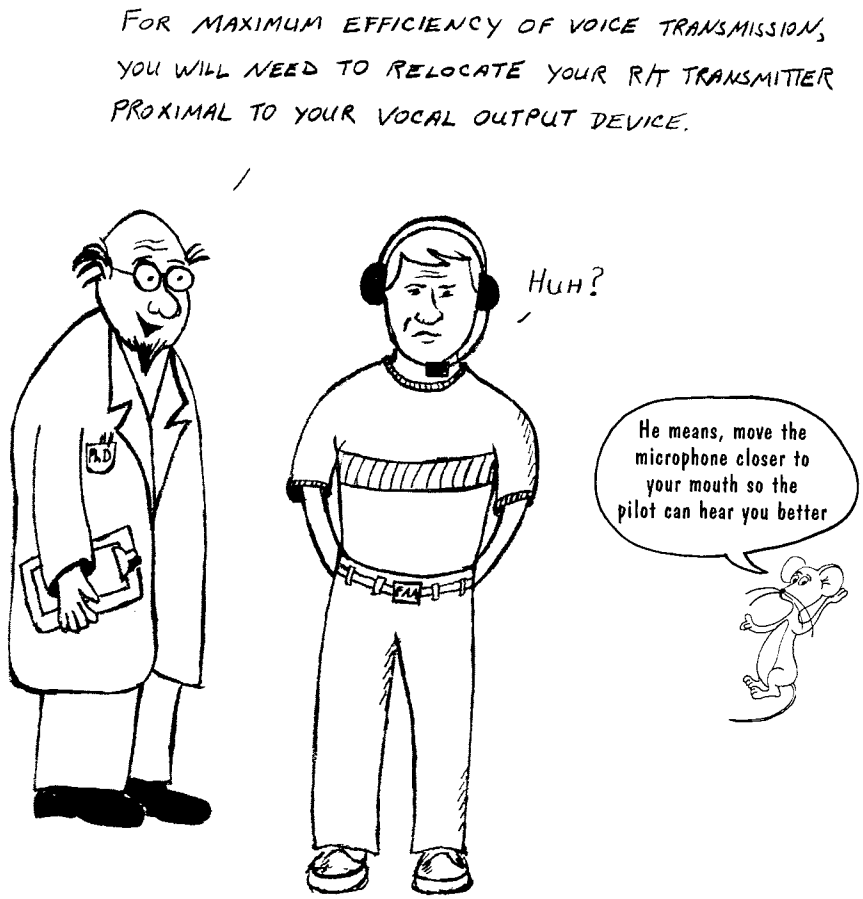




Speaking slowly and distinctly gives any listener a better chance of correctly hearing what was said. However, it is especially important to speak S-L-O-W-L-Y and DISTINCTLY to foreign pilots.

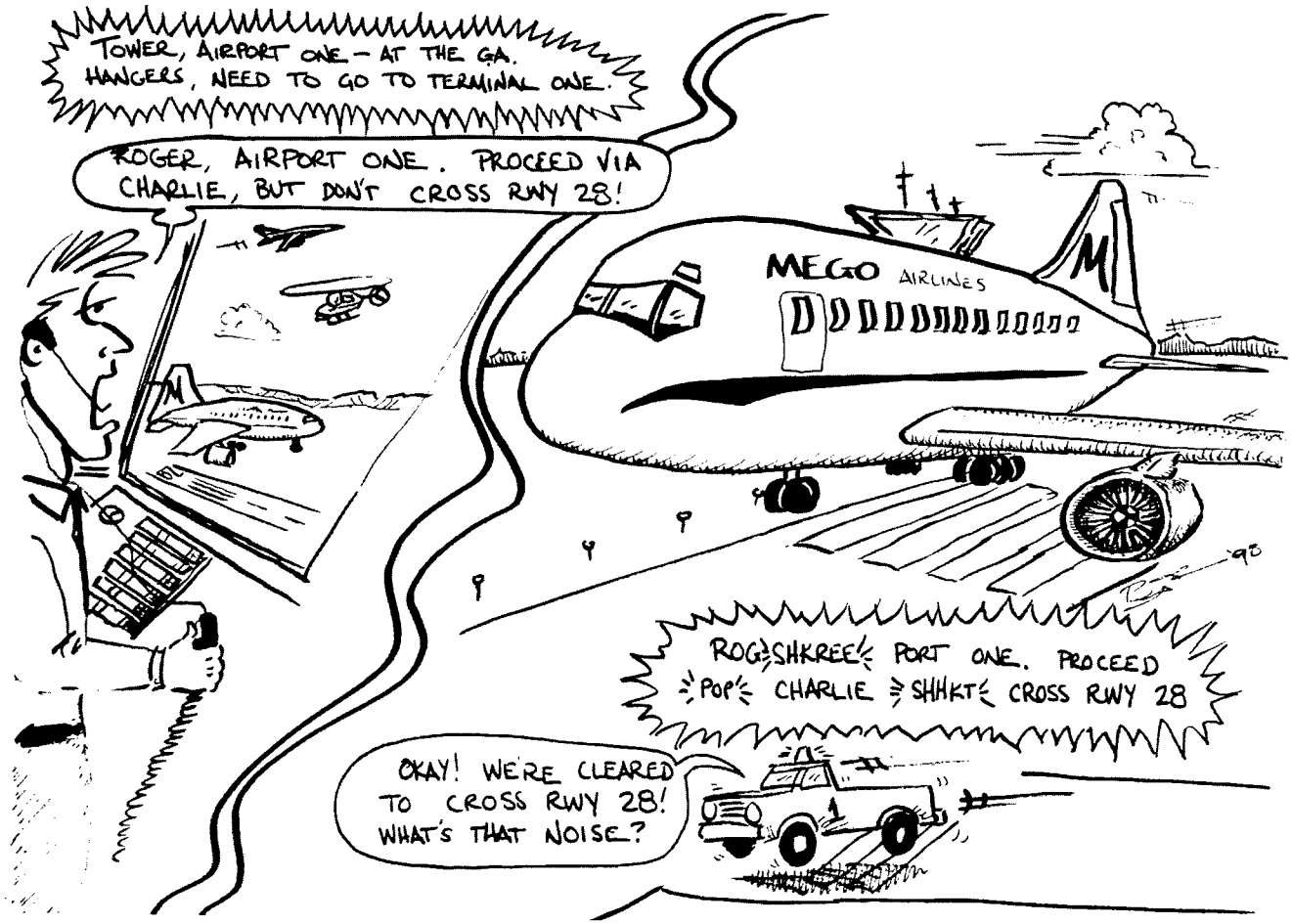
As we speed up our speech rate, we lose many of the cues that help us tell the difference between certain speech sounds. Those cues can mean the difference between understanding the clearance that was issued and needing to ask for a repeat, especially for pilots whose native language is not English.

Good microphone technique is critical to prevent clipping call signs: don't forget to pause for a second after keying the transmitter before speaking. Also, make sure that the microphone is close to your mouth, otherwise pilots might have trouble hearing you.



Even when its not clipped, we often don't hear the first syllable of a message. We also tend to hear and act on the "action word" that we hear (such as "cross"). That's one reason why we say "hold short" and ***not*** "don't cross." Conditional clearances present similar problems. Many a pilot has taken a runway immediately after hearing, "Position and hold *after* landing traffic." [6]

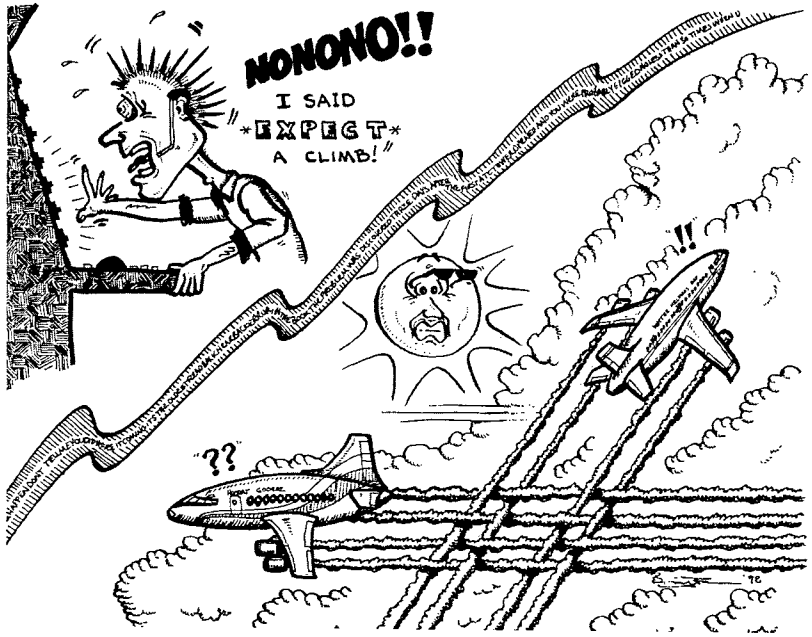
Always be sure that the action word in the instruction is what you want the pilot to do.


TOWER, AIRPORT ONE – AT THE GA. HANGERS, NEED TO GO TO TERMINAL ONE.
ROGER, AIRPORT ONE. PROCEED VIA CHARLIE, BUT DON'T CROSS RWY 28!
MEGO AIRLINES
ROG SHKREE PORT ONE. PROCEED POP CHARLIE SHHKT CROSS RWY 28
OKAY! WE'RE CLEARED TO CROSS RWY 28! WHAT'S THAT NOISE?

Avoid issuing strings of instructions to different aircraft. A pilot's memory for an instruction is hindered by extraneous information presented before and after it.

Issue "expect" instructions with caution and emphasize any differences between the actual clearance and what the pilot was told to expect.

Many a pilot has followed what they were told to expect rather than the actual clearance. In fact, a study of Aviation Safety Reporting System (ASRS) reports found that 33% of the communication errors between the cockpit and ATC that resulted in runway transgressions identified **pilot expectations** as contributing to the error.[7]



In one close call, a B-727 was told to expect to land on Runway 4L but later cleared to land on 4R. The pilot did not readback the clearance, nor did the controller request it. The aircraft landed on 4L while another B-727 was holding in position on the displaced threshold. The crew of the landing aircraft did not see the holding aircraft until they were almost over it. This incident occurred at night and the only lights on the holding aircraft were the navigation lights, taxi light and rotating beacon. (NTSB Report Number NYC93IA065).

ALWAYS inform the pilot when there is a similar call sign on the frequency.

Similar call signs is the number one factor contributing to a pilot accepting another aircraft's clearance.[7]

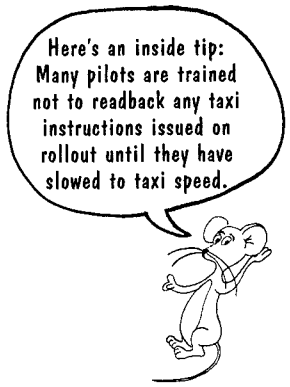
Memory is "constructive," that is, we have a tendency to "fill in the blanks." More than one pilot has taken off without a clearance after receiving an instruction like "fly heading 310 on departure."

Giving instructions when the action is required helps to ensure that pilots will comply with the instruction in a timely manner.

The timing of a clearance can be as important as the content for successful communication with pilots.

Consider this: In a simulation study of a taxiway guidance system (Taxiway Navigation and Situation Awareness or T-NASA) at NASA-Ames Research Center, two-thirds of the pilots readily noticed when controllers gave them taxi instructions to the wrong concourse. However, when the erroneous instruction was given outside the outer marker, NONE of the pilots caught it right away.[8]

On the other hand, **landing and rollout is NOT the ideal time to try to get the pilot's attention.** The cockpit is noisy (thrusts reversers weren't designed to be quiet), the pilot workload is particularly high and the pilot's attention is focused on getting the aircraft safely on the ground, cleaned up, slowed down, and off the active runway. If you give taxi instructions under these circumstances, you risk the pilot not hearing it. A good rule of thumb is to not issue routine instructions unless the aircraft is at (or below) normal taxi speed.

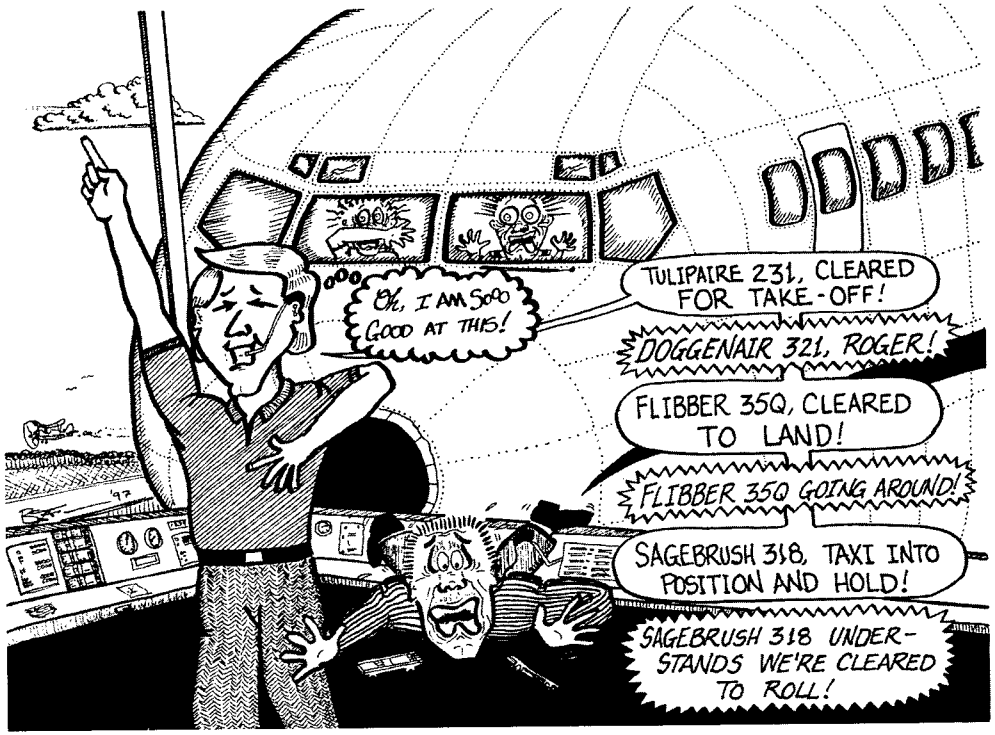


If you need an aircraft to clear the runway at a particular exit, tell the pilots well before landing. This gives them the chance to find the exit on the airport diagram, determine if they will be able to comply, and plan accordingly. It gives YOU a better chance that they will either comply with the instruction or let you know early that they can't.

The instruction to a landing aircraft to "Take the next exit" off the runway should only be given once the aircraft has slowed to taxi speed. Adding "advise if unable" will help ensure that the pilot will let you know – sooner rather than later – if they won't be able to comply.

Instructions to a pilot to "follow" another aircraft are often helpful to pilots as well as controllers. However, limits to the "follow" clearance need to be specified. Pilots have been known to erroneously follow the other aircraft right across (or even *onto*) an active runway.

It is all too easy to hear what we expect to hear rather than what was actually said. This is one reason why catching readback errors is such a difficult task. Use the pilots' readbacks like you do any other piece of information. Actively listen to the readbacks and check them against other information (such as strip notations). This will help to guard against hearback errors and serve as a check that you issued the clearance that you intended to issue.



Chapter 4

The Importance of Teamwork: Four Eyes and Ears are Better than Two, Six are Better than Four...

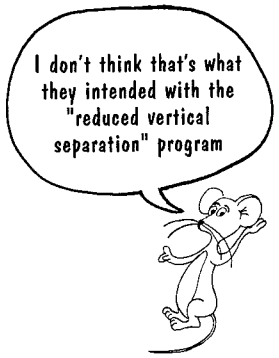
When teamwork suffers, everybody loses.

Teamwork is especially important in the tower. Many operational errors have been attributed to the failure of one controller to coordinate with another. Lack of, or incomplete, coordination among controllers was identified in 18% of the tower operational errors.[2]

> In daylight IMC, with Runway Visual Range reported at 3,000 ft., a B737 captain - just after touchdown - observed the amber rotating beacon on a vehicle about 1,000 ft. ahead on the runway. The captain made an immediate "go-around" and missed the eight vehicles by an estimated 10 ft. (NTSB Report Number CHI84IA127) What happened? While the aircraft was 15 miles SW of the airport and being vectored for a runway 36 Cat II approach, the local controller had given the ground controller permission for snow removal equipment to proceed north on runway 36 and to exit runway 36 at the intersection of Runway 27L. The aircraft reported at the outer marker and was cleared to land with no further conversation between controllers about the status of the snow removal equipment.

We are all creatures of habit with tendencies to resort to the way things are normally done. Airport construction and other "non-normal" situations can present problems for controllers as well as pilots. Non-standard operations require particular vigilance because our "automatic" reactions may not be the right ones in unusual situations.

"Ground control requested to cross a small airplane at the departure end of Runway 31. I approved it. This is a non-standard operation due to the main taxiway being closed for construction. The airplane pilot turned onto the runway instead of crossing it as instructed. He observed a jet turning onto Runway 31 for departure. He moved over to the edge of the runway, but never said anything. The color of the aircraft and its position were such that it blended in with the runway paint. I cleared the jet for takeoff, then observed the airplane just prior to the jet rotating. After the jet passed over the airplane, the pilot asked Ground Control if he was in the right place.
(ASRS Callback Number 231, September 1998)



Even "normal tasks" can be distracting. Its possible to focus so much attention on one situation that another, equally critical situation, is inadvertently neglected. Consider the following excerpt from the results of an NTSB accident investigation:

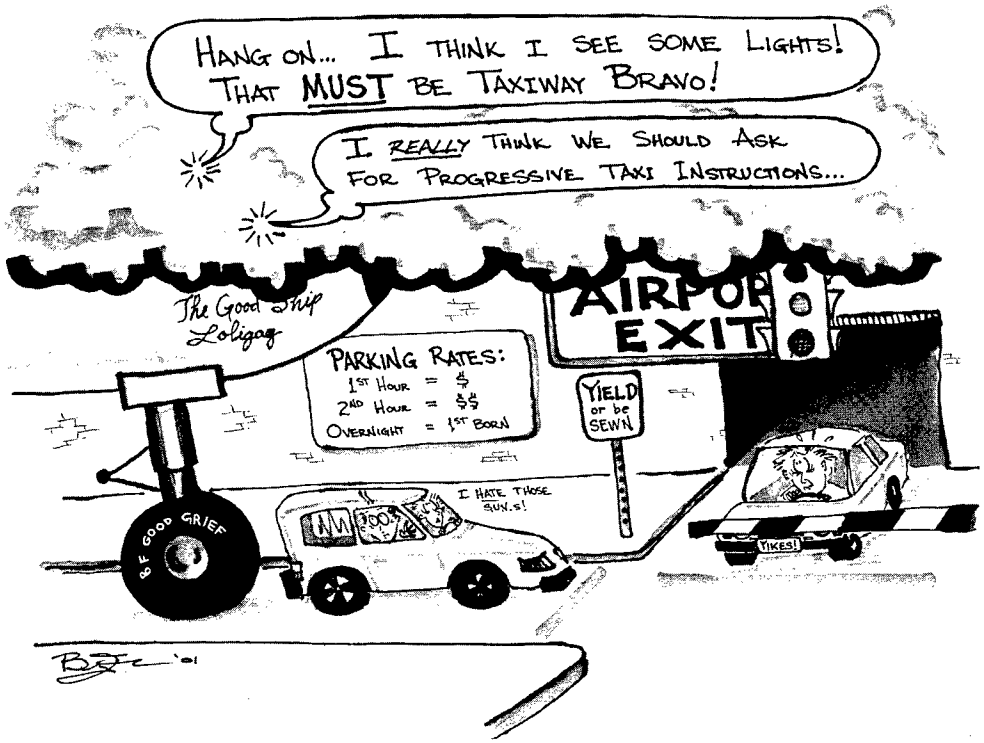
> "It is recognized that concentration on one task can overload a person to the extent that other relevant cues are disregarded or otherwise not attended to, leading to a degradation of overall task performance. Because the north local controller focused his attention on the path of (aircraft A) ...., he was distracted at a critical time from the landing rollout of (aircraft B) and (aircraft C) that was about to cross the threshold and land on the same runway." (NTSB/AAR-91/08).

All the more reason to keep your scan and work as a team.

Pilots – the other part of the "Team"

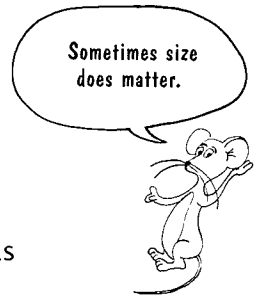
When in doubt, ask questions. A few extra seconds on the frequency is preferable to the paperwork of an operational error for an honest, but avoidable, mistake.

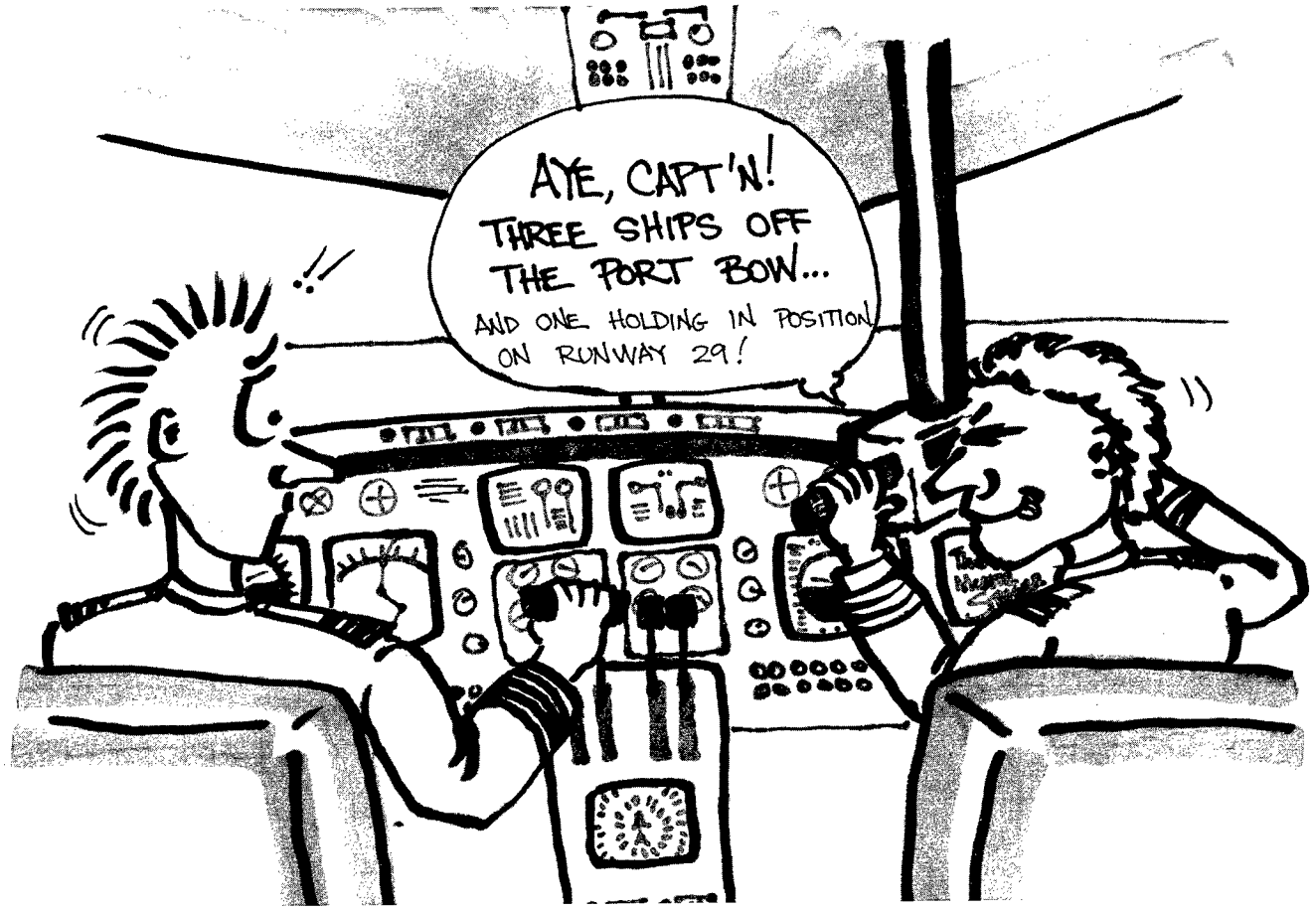
If you're puzzled as to how pilots can easily get confused at a certain spot on the airport, drive it sometime and see it from the pilots' view.



You might think that losing sight of a big plane in Visual Meteorological Conditions (VMC) during the day would be about as easy as losing an elephant in a taxi cab. But, converging runways and taxiways present special challenges to pilots as well as controllers. Consider this:

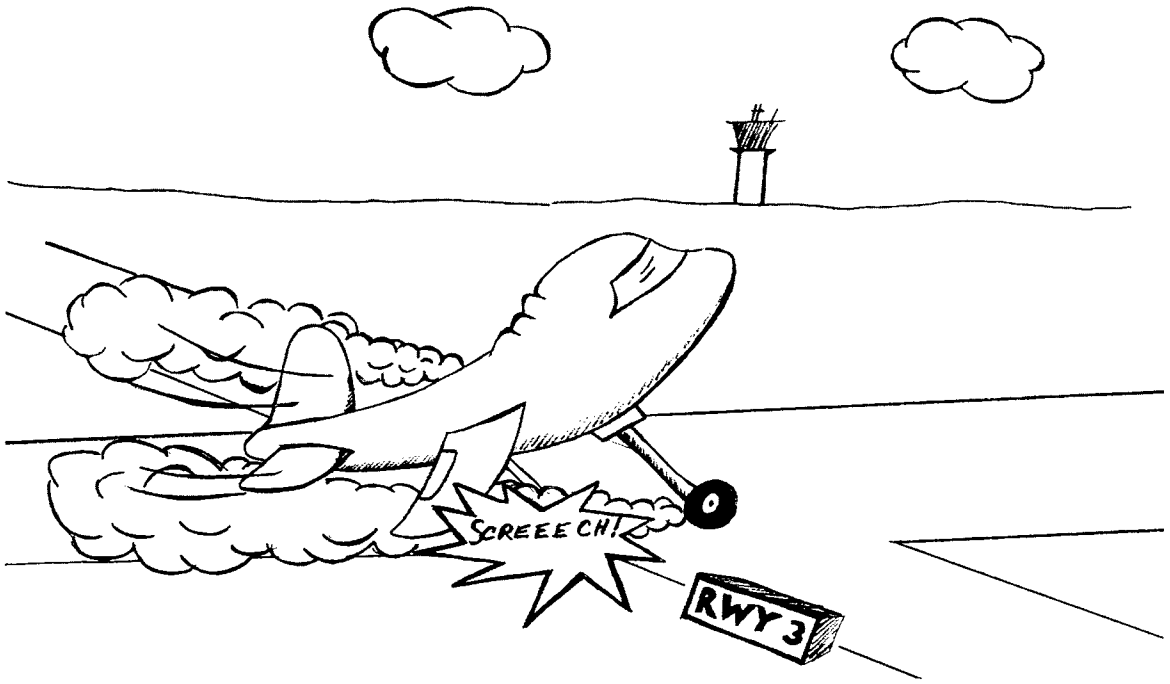
> A Cessna 401 was cleared to taxi from the ramp to the runway and was advised of the "Boeing clearing that runway." The Cessna advised having the aircraft in sight and taxied from the ramp to taxiway Bravo. After turning onto taxiway Bravo, the captain lost sight of the 737 as the first officer was "occupied with duties inside the cockpit and did not see the 737 until immediately before the collision." The 737 crew said they never saw the Cessna. According to witnesses, the two aircraft were moving in the same direction at the same speed on the converging taxiways. The left wing of the 737 impacted the rudder of the Cessna as the 737 merged from Mike onto Bravo. (NTSB Report Number FTW95FA319A)




AYE, CAPT'N!
THREE SHIPS OFF THE PORT BOW...
AND ONE HOLDING IN POSITION ON RUNWAY 29!

Don't ask for the impossible. In a battle against the laws of physics, everybody loses.

On approach, aircraft can typically go lower or slower, but not both at the same time. Slowing the aircraft *before* you descend it will increase the chances of the aircraft being able to do what you want it to do. Also, when asking if a pilot can hold short of an intersecting runway or taxiway after landing, you need to take the weather and runway conditions into account. For large aircraft, you also need to give the flight crew enough time to calculate whether or not they can comply given their current weight, etc.



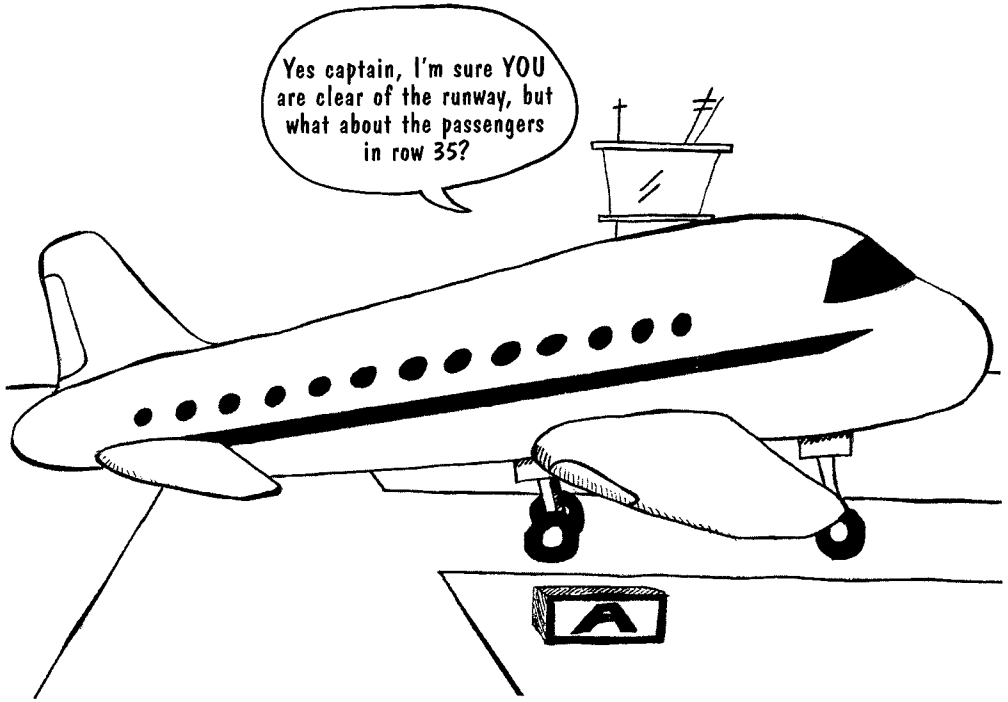
You need to change the runway assignment. But do you REALLY know what this means for the pilot? The approach is already a relatively high workload phase of flight; unanticipated changes make it even more so. Then, there is the fact that:

- Some planes require that a specific runway be entered into the Flight Management System (FMS) in order to provide the flight crew with appropiate guidance; this means that reprogramming the FMS may be necessary, because simply "hand flying" the aircraft with inaccurate and distracting flight guidance is not an easy option. (Note: Some air carriers have procedures that say that the FMS should not be reprogrammed below 10,000 feet, because of the increase in workload and increased head-down time during a critical flight period.)
- Most air carriers require a multiple-part approach briefing be given for each specific approach before landing. (New runway means new briefing, another duty during a high workload, and less attention available for watching for conflicting traffic.)

Bottom line – be aware that changes in a runway assignment may mean that significantly more of the pilot's attention will be required to accommodate the change - attention that could otherwise be used to look for traffic and listen for a clearance.

Food for thought: "Report clear of the runway" – sounds simple enough. But it's not always easy for pilots of large aircraft to tell if they are completely clear of the runway. Some airports – particularly those built before the era of jumbo-jets - have runway exits with minimal room between a landing runway and the parallel runway or taxiway. There is no standard ground reference (or other information that is consistently available to the pilot) – either in the cockpit or on the airport – to help them make this decision; nor is there a part of their required training that addresses how to judge when the aircraft is clear. All they have is their educated guess that the line that was in front of their plane is now the right distance behind it. In small aircraft, this is not a problem; but imagine driving an 18-wheeler and trying to judge how far you are from the stop sign you just passed (without peeking in the rear view mirror). Since neither pilots nor controllers have any mechanisms to determine whether or not an aircraft is clear of the runway, it can be tricky.

On takeoff roll, the crew of the airliner attempted an evasive swerve to avoid contact with the elevator of another airliner that was not clear of the runway. The left wing struck the right elevator and both airplanes had minor damage. (NTSB Report number MIA92IA077A)

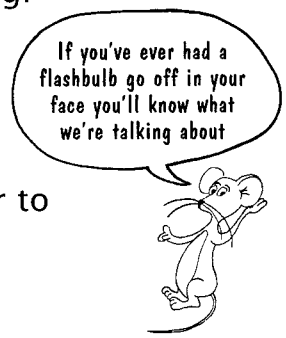


Questions & Answers

Ask Pat the Pilot (The Controllers' Guide to Understanding Pilot Behavior)

Q: Why do pilot sometimes turn their landing lights on and off while taxiing?

A: When pilots turn their landing lights on and off while taxiing, it's not a pilot Morse code – it's just a considerate attempt to avoid temporarily blinding another pilot by shining a landing light in their eyes.



Want information on air traffic control? Whether you want to get an answer to a sophisticated question or you just want some cyberspace to send that annoyingly inquisitive niece or nephew to, go to the most informative and comprehensive ATC-based web site on the planet:

> Visit www.atchelp.com <http://www.atchelp.com> today for your one-stop shot in ATC needs! Our Air Traffic Control web site provides ATC training and public education about the ATC environment. We are "Informing Controllers Around The World. Take part in our mission of improving safety through discussion and education."
>
> Another great web site is www.natca.org - the web site for the National Air Traffic Controllers Association (NATCA).

Is there a situation that you feel is unsafe but no one wants to listen? Want to help prevent someone from making the same "honest mistake: that you just made? File an ASRS report – your voice WILL be heard. ASRS is conducting a special study on runway incursions. Now it's more important than ever that you take the time to fill out the report (http://asrs.arc.nans.gov/foms_nf.htm) - especially those incidents that occurred in the last six month and resulted in a serious hazard or near-collision.

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Chapter 5

Fatigue Busters:

Tips for Sleeping Better and Maintaining Alertness on the Job

GET ENOUGH SLEEP.

Optimal performance is impossible without adequate sleep. Sleep is necessary for both our physical and psychological well-being. Not getting enough sleep can affect memory, and our ability to perform complex tasks (like the planning and problem-solving necessary to predict and resolve conflicts between aircraft. Sleep deprivation can also lead to slower decision-making and lapses in attention.[9]

Working on a schedule that changes constantly, or changing from a night shift to a day shift with minimum rest, presents serious challenges to getting enough sleep. In fact, while only 15% to 20% of day workers report suffering sleep disturbances, up to 80% of shift workers who work night shifts report this problem.[10] Counterclockwise, rapidly rotating, shifts (such as afternoons to days or midnights to afternoons) are the most difficult to adjust to because the change goes against our body's internal clock. This often results in sleep loss and fatigue. In a recent survey of over 6,000 air traffic control specialists (ATCSs), 91% reported working counterclockwise rotating schedules. It is no surprise that 67% of ATC shiftworkers reported having trouble sleeping and 46% reported that they often fall asleep unintentionally.[11]

Recovery from severe, extended sleep deprivation is not as easy as you might think. In one study, people who were only allowed to sleep three hours each night for seven days needed two, three, and sometimes even more nights of unrestricted sleep to be able to do as well on complex cognitive tasks as they could before the sleep loss.[9]

A critical step in maintaining alertness on the job is getting sufficient quantity and quality of sleep **off** the job. This means not only getting an adequate amount of sleep (for most people, 7 to 8.5 hours), but also getting uninterrupted sleep. Interruptions to your sleep reduce the quality of your sleep. Sleep disruptions can also deprive you of the deep stage of sleep. All of this means that even an adequate time spent sleeping may not make you feel rested when you wake up; quality is as important as quantity.

"People who exercise regularly fall asleep faster, sleep for a longer time, spend less time awake during the night, and get more deeper slow-wave sleep than people who don't exercise....the *earlier* in the day [you exercise], the bigger the increase in deeper sleep."[12]

Still need a nightcap? Try a hot bath before bedtime. At least one study showed that it can lead to a better night's sleep–less restlessness during the night and feeling more rested in the morning.[13]

Even a small sleep decrement can affect performance. Know your limitations.

Did you know that there is an increase in traffic accidents on the Monday after daylight-saving time begins and a decrease in accidents on the Monday after the return to standard time?[14]

MORE SLEEP BUSTERS:

ALCOHOL

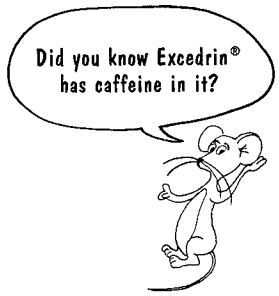
Drinking alcoholic beverages may help you to fall asleep faster, but it will make the **quality** of sleep that you get worse than it would have been if you had no alcohol.

LIGHT, HEAT, and NOISE

Sleep in a cool, dark, quiet place. Constant "white noise" (like the hums produced by air conditioners and fans) help to cover up other noises, making them less likely to disturb your sleep.

PAIN RELIEVERS

Some pain relievers can also interfere with getting enough sleep. In one study, people who were in no pain and given aspirin or ibuprofen (e.g., Advil®, Motrin®) before bed, woke up more often and spent more time awake during the night than when they took acetaminophen (e.g., Tylenol®) or a placebo.[15]



SLEEP BUSTERS:

CAFFEINE

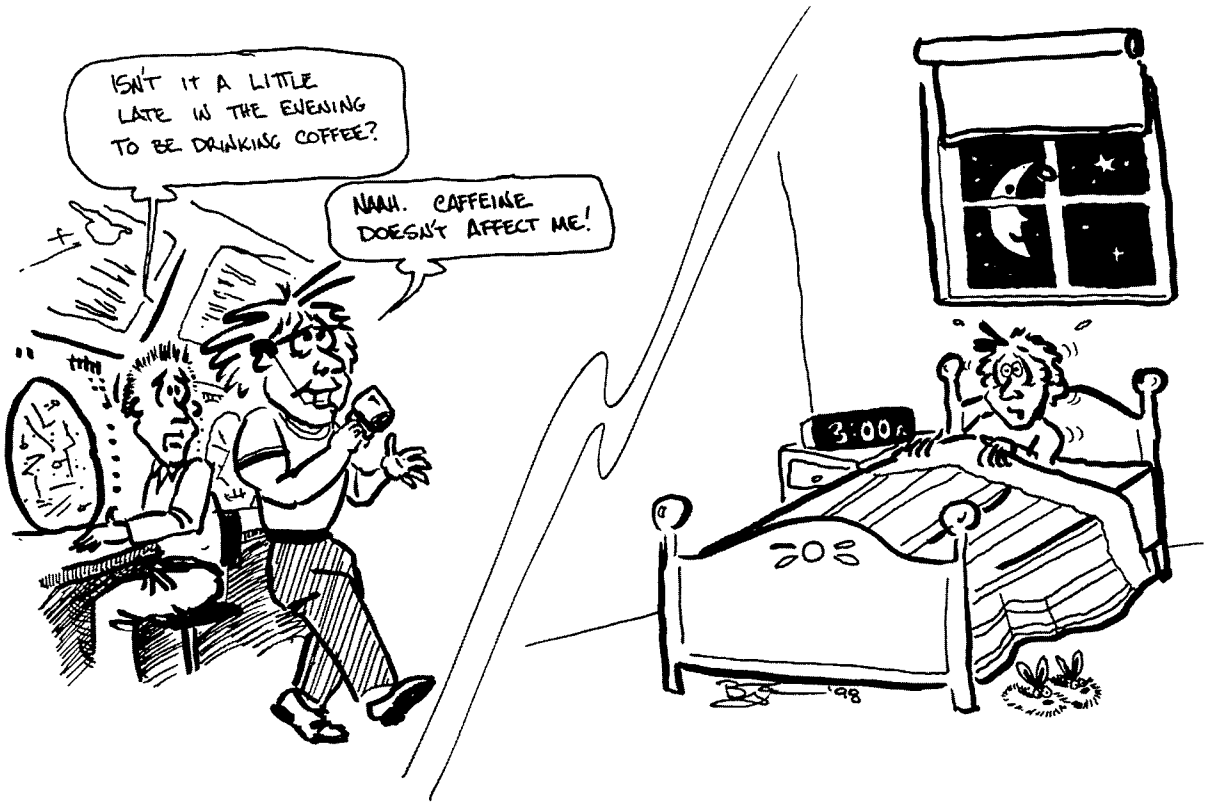
Everyone knows that drinking coffee near bedtime can make it difficult to get to sleep. What you may not know is that caffeine can also disrupt sleep even in people who fall asleep easily after consuming caffeine. For a better night's sleep, avoid caffeine for six hours before bedtime.

SMOKING

Nicotine is a stimulant and cigarette smoking can interfere with sleep.[16]

> "When eight men who had consistently smoked between one-and-a-half and three packs of cigarettes a day for at least two years were persuaded to stop abruptly, they fell asleep faster and woke less during the night, reports Constantin Soldatos, M.D. and his colleagues at Pennsylvania State University. These improvements occurred despite unpleasant daytime effects of (abrupt) cigarette withdrawal..." (p. 127).[17]

If you are a smoker who has trouble sleeping, now you have one more reason to quit. And, if you are a smoker who would like to be a non-smoker, see your doctor. There are new and effective ways to help you quit for good.


ISN'T IT A LITTLE LATE IN THE EVENING TO BE DRINKING COFFEE?
NAAH. CAFFEINE DOESN'T AFFECT ME!
3:00

THE PROS AND CONS OF CAFFEINE:

Caffeine can increase vigilance and decrease the feeling of fatigue. It can also postpone sleep (whether you want it to or not), impair the quality of the sleep that you get, and can increase heart rate and blood pressure. It is important to know that caffeine has its peak effects one to three hours after you consume it.

People who have caffeine regularly develop a tolerance to it and eventually need more caffeine to feel the same effect. This makes it more difficult to use caffeine "strategically," because you will get less of an effect when you want it most.

People who don't regularly consume caffeine will be more sensitive to its effects (and will find it easier to use caffeine strategically). Sensitivity to caffeine also changes with age so that as we get older, we get more of a "jolt" from the same amount of caffeine.

If you're trying to cut down on caffeine, do it gradually. Going "cold turkey" can lead to headaches.


I DON'T THINK IT REALLY REQUIRES A DEGREE IN PSYCHOLOGY TO KNOW THAT YOU'VE GOT A SERIOUS ADDICTION TO CAFFEINE!

CAFFEINE: WHERE TO FIND IT AND HOW TO AVOID IT

Beverages:

Cup of Coffee - 135 mg per cup.[18] (This can vary widely, however, with the strength of the coffee.)

Tea - 50 mg in 1 cup, Instant tea - 30mg in 5 ounces[19]

Coke - 75 mg in 20 ounces , other Colas - 37-45 mg in 12 ounces[17]

Sunkist Orange Soda - 41 mg in 1 cup[18]

Chocolate milk - 5mg in 8 ounces[19]

Water (the bottled caffeinated kind) Aqua Java - 50 to 60 mg in 17 ounces,

Krank 2-0 - 100 mg, Java Water - 125 mg[18]

CAFFEINE: WHERE TO FIND IT AND HOW TO AVOID IT

Snacks and Miscellaneous:

Starbucks coffee ice cream - 40-60 mg in 1 cup[18]

Dannon coffee yogurt - 45 mg in 1 cup[18]

Excedrin - 130 mg in 2 tablets, Anacin - 64 mg in 2 tablets[18]

Cascadian Farm Mocha Fudge frozen yogurt - 70mg in 1 cup[20]

Healthy Choice Lowfat Cappuccino Mocha Fudge ice cream - 20 mg in 1 cup[20]

Stonyfield Farm frozen yogurt or ice cream - all coffee and mocha flavors - 0 mg[20]

Tips to Maintaining Alertness on the Job:

Now that you know how to get a good night's (or day's) sleep, here are some other tips to help ward off fatigue and keep you alert:

- Stand up, stretch, and walk around as much as possible.
- Eat frequently and wisely to prevent low blood sugar.
- Spend break time under bright lights.

Did You Know That:

Wearing sunglasses, eating green leafy vegetables, and not smoking can help protect your eyes by preventing macular degeneration - a leading cause of blindness in people over 55 that affects almost 30% of people over 75.[21,22]

You may see clear or opaque specks or threads that drift across your vision and move with your eyes (these are called "floaters") or flashes of light that aren't really there. These can be perfectly harmless OR an indication that a serious problem is developing (such as a tear in the retina). Only your eye doctor can tell the difference. Getting a problem taken care of early is easy and can help save your sight.[23]

Certain medications can affect your color vision. For example, Viagra® (sildenafil) can affect the ability to tell the difference between green and blue. For this reason, Dr. Donato Borillo, the Commander of Flight Medicine at Wright-Patterson Air Force Base, recommends that pilots allow at least six hours between taking Viagra and flying.[24] Other drugs can also affect color vision - ask your doctor.

Wearing sunglasses changes the appearance of colors on a display and can increase your chances of mistaking one color for another.

Did You Know That...(cont'd)

Want to protect your hearing? Then stay away from loud noises to guard against "noise-induced hearing loss." Noise-induced hearing loss can be the result of a one-time exposure to an extremely loud noise, repeated exposures to loud noise or extended exposure to moderate noise. This type of hearing loss is usually gradual, painless, and permanent. So turn down the loud music, use a headset instead of a speaker when flying, and wear noise-reducing earplugs when you're using power tools or in a noisy environment. Any sound louder than 80 dB is potentially hazardous.[25] Simply put, if you need to raise your voice to be heard over the noise, then the noise is loud enough to damage your hearing with long-time exposure.

Tinnitus or "ringing in the ears" is the perception of any sound (ringing, buzzing, whistling, etc.) that isn't in the environment. Most people experience it at one time or another.[26] Tinnitus may be a symptom of a problem — such as hearing loss, an ear infection, an obstruction, or other disorder — that requires medical attention.[26] However, it can also be a side-effect of some common medications such as aspirin, ibuprofen (Advil®, Motrin®), certain antibiotics, or alcohol.[27,28] It can also be caused by noise exposure, hypertension, anemia, or stress.[26]

If you wear glasses or contacts and your prescription isn't as strong as it should be, you could be suffering from headaches needlessly. An undercorrection can cause headaches, particularly when you spend a lot of time using a computer screen.

See pages A-1 to A-14

Chapter 5

Fatigue Busters:

Tips for Sleeping Better and Maintaining Alertness on the Job

References

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Appendix - Airports with ASDE-3 as of January, 2001.

ANC	Anchorage
ADW	Andrews
ATL	Atlanta
BOS	Boston
BWI	Baltimore/Washington
CLE	Cleveland
CLT	Charlotte
CVG	Covington/Cincinnati
DCA	Washington (National)
DIA	Denver
DFW	Dallas/Ft.Worth
DTW	Detroit Metro
ERW	Newark
IAD	Washington (Dulles)
IAH	Houston
JFK	New York
LAS	Las Vegas
LAX	Los Angeles
MCI	Kansas City
MEM	Memphis
MIA	Miami
MSP	Minneapolis
MSY	New Orleans
ORD	Chicago (O'Hare)
PDX	Portland
PHL	Philadelphia
PIT	Pittsburgh
SAN	San Diego
SDF	Louisville
SEA	Seattle
SFO	San Francisco
SLC	Salt Lake City
STL	St. Louis

Readback Error – An incorrect repeat of the controller's transmission by the pilot. For example, if the controller said, "Air Carrier 123, Descend and maintain one one thousand," and the pilot responded with "Roger, one zero thousand for Air Carrier 123," this would be a readback error since the pilot should have read back the altitude of 11,000.

Runway Incursion (RI) – Any occurrence at an airport involving an aircraft, vehicle, person, or object on the ground that creates a collision hazard or results in a loss of separation with an aircraft taking off, intending to take off, landing, or intending to land.

Surface Incident (SI) – Any event where unauthorized or unapproved movement occurs within the movement area or an occurrence in the movement area associated with the operation of an aircraft that affects or could affect the safety of flight. SIs result from PDs, OEs, vehicle or pedestrian deviations (V/PD), or operational deviations.

Vehicle/Pedestrian Deviation (VPD) – Any entry or movement on the runway movement area by a vehicle or pedestrian that has not been authorized by ATC (includes aircraft operated by non-pilots).

Definitions

ASRS – Aviation Safety Reporting System.

ATC – Air Traffic Control.

Collision Hazard – Any condition, event, or circumstance that could induce an occurrence of a collision or surface accident or incident (e.g., a pilot take an unplanned or evasive action to avoid an aircraft, vehicle, object, or person on the runway).

Hearback Errors – The failure, on the controllers' part, to notice or correct a pilot's readback error.

Loss of Separation – As defined in Order 7110.65, an occurrence or operation, which results in less than the prescribed separation between aircraft, vehicles, or objects.

Operational Error (OE) – The actions of an air traffic controller that causes a loss of separation as defined in Order 7210.56A.

Pilot Deviation (PD) – The actions of a pilot that result in the violation of Title 14 of the Code of Federal Regulations or a Federal Aviation Regulation.

Readback – A pilot's acknowledgement of a controller's transmission that repeats the information hat the controller conveyed.

Help On the Horizon

The FAA is paying new attention – as well as dollars – to reduce the number of runway incursions and improve runway safety. Efforts in progress include: preventing radar at additional airports or improving airport signs and markings, improving communications between controllers and pilots, and exploring new technologies. Some improvements are a lot closer than others, but here are some promising technologies:

- Passive Final Approach Spacing Tool (pFAST) [and the newer version- Active Final Approach Spacing Tool (aFAST)] should help reduce the number of changes in runway assignments.
- Expanded use of SMGCS, (pronounced "smigs")-Surface Movement Guidance and Control System would enhance taxiing capabilities in low visibility conditions.
- Moving map displays that show the pilot the aircraft's position on the airport surface could reduce the number of pilots lost on the airport surface and "wrong turns."
- Surface markers linked to existing aircraft equipment could inform pilots either that they are approaching a runway or of their specific position on the airport surface (without a moving map display).
- Loops – sensors implanted on the runway surface would indicate to controllers what part of the runway is occupied.

- Enhanced vision systems for the tower could help controllers in low visibility (nighttime/low visibility conditions are associated with runway incursionsthat result in accidents and close-calls).
- Runway status lights that provide a direct warning capability to pilots to warn them a runway is occupied.

For more information on the projects contained in the FAA Runway Incursion Reduction Program, visit http://www.aea200.ea.faa.gov/ea11/runway.htm

Is there a situation that you feel is unsafe but no one wants to listen? Want to help prevent someone from making the same "honest mistake" that you just made? File an ASRS report – your voice WILL be heard. ASRS is conducting a special study on runway incursions. Now its more important than ever that you take the time to fill out the report (http://asrs.arc.nasa.gov/forms_nf.htm)– especially those incidents that occurred in the last six months and resulted in a serious hazard or near-collision.

Terry Technician addresses a commonly asked question:

Q: Why can't we just put stop lights at runway entrances – you know, red for "stop" and green for "go?"

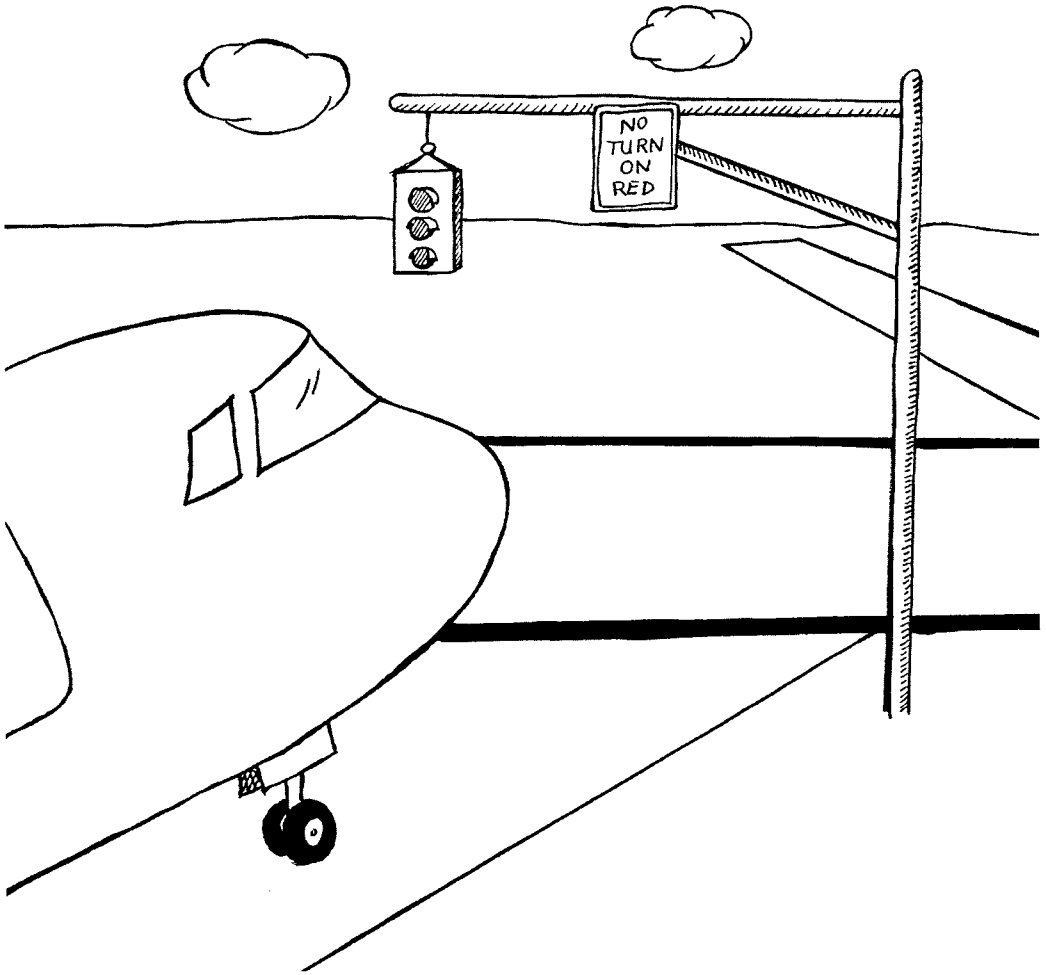
A: The answer to this question has more to do than with people than technology. First, there is the important issue of controller workload. In order for such a system to work, the controller would have to flip a switch (or equivalent action) with every clearance to take or cross a runway. There are two problems with this; the controller could forget to flip the switch (leading to a red light with a clearance to cross or a green light with a "hold short" instruction). Also, the addition to controller workload could lead to other controller errors. Such a system would be likely to require a dedicated controller (much like the controller who monitors the parallel runway monitor for closely spaced parallel approaches). This raises the issues of staffing and controller coordination.

Another possibility is runway status lights. These lights on the entrances to a runway would tell pilots whether or not the runway is clear (that is, no occupancy and no one on short final). It's NOT a substitute for a clearance, just good back-up information for the pilot. See the next section "Help on the Horizon" for other possibilities.

Want more information on air traffic control? Whether you want to get an answer to a sophisticated question or you just want some cyberspace to send that annoyingly inquisitive niece or nephew to, go to the most informative and comprehensive ATC-based web site on the planet:

Visit www.atchelp.com today for your one-stop shot in ATC needs! Our Air Traffic Control website provides ATC training and public education about the ATC environment. We are "Informing Controllers Around The World. Take part in our mission of improving safety through discussion and education."

Also visit the web site for the National Air Traffic Controllers' Association (NATCA) at www.natca.org.


NO
TURN
ON
RED

A: While some of what controllers are required to say comes from lawyers, this one is actually rooted in reason. There is a phenomenon called "ionic bounce," where radio waves bounce off the upper atmosphere and "show up" far beyond the normal radio range of the transmitter. The radio transmitters for the towers are low-power, designed to keep the reception area to less than 30 miles. But due to ionic bounce, a transmission could show up in an entirely different region, where there could be a tower with the same frequency.

That's why we're required to identify ourselves on initial call-up; so the pilot knows their actually talking to the facility they're suppose to be talking to and not getting a rouge transmission from another tower that's 100 miles away.

For a detailed explaination of ionic bounce go to:

http://www.fas.org/spp/military/docops/afwa/U3.htm

http://www.tpub.com/neets/book10/40e.htm

Questions & Answers

Ask Chris the Controller (The Pilots' Guide to Understanding Controller Behavior)

Q: What does it really mean when controllers say "standby?" Are they thinking, sipping coffee, or just laughing at our request?

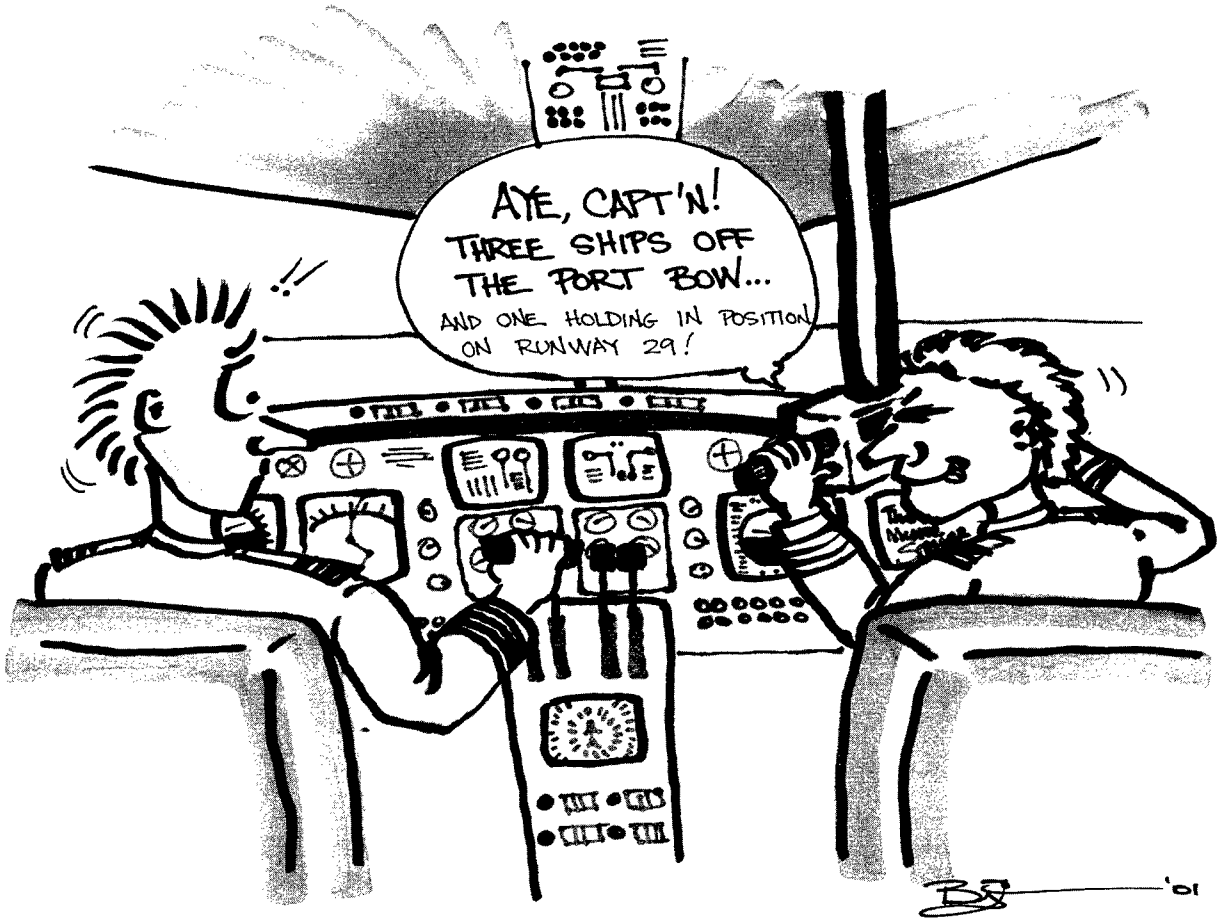
A: A controller might tell you to "standby" for a number of reasons. Sometimes they have to coordinate your request with another controller, or check something else before they can grant it. The controller might also be in the middle of another "call" - like talking to another controller. While controllers can hear all of the calls going to your radio, you cannot hear all of the calls going to them.

Q: Why do controllers have to identify themselves as "Great Airport Ground?" After all, I either had to drive here or land here – you'd think I'd know where I am by then.

Use your aircraft lights to help controllers and other pilots see you:

- Fixed navigation lights (red, green, and white) and taxi light should be ON whenever the aircraft is moving.
- When cleared into "position and hold", turn on all external lights including logo lights.
- Landing lights should be turned on either when taking the active runway or when cleared for take-off.
- Logo lights are especially helpful to controllers as they help to identify your aircraft.

Remember, if you're not part of the solution, you're part of the problem.


AYE, CAPT'N!
THREE SHIPS OFF THE PORT BOW...
AND ONE HOLDING IN POSITION ON RUNWAY 29!
'01

Preventing Runway Incursions is a SNAP if you:

Scan the entire runway and final approach area before entering or crossing a runway.

Never go "heads down" or off-frequency unless you're clear of all runways.

Are certain of the assigned runway, your position on the airport surface, and the exact clearance.

Pre-taxi or pre-landing briefing with the airport diagram in hand; know what's between you and your runway or you and your gate. Is there a parallel or intersecting runway?

One pilot's awareness of the surface situation and refusal to take-off was the only thing that prevented the collision of two air carrier aircraft.

On December 6, 1999, with visibility of 1/4 mile in fog, a disoriented pilot erroneously reported their position, but then stated correctly that they were on the active runway. The controller (with no surface radar at the facility) thought the errant aircraft was well clear of the active runway and cleared another aircraft for take-off. The pilot of that aircraft, however, informed the tower that they were "staying clear of all runways until they figure out where the [other aircraft] is."

There are countless instances of a "heads-up" saving the day. Pilots can catch and correct controller mistakes – before a mistake turns into an accident - just as controllers can catch and correct pilot mistakes, before an incident becomes an accident.

> In daylight IMC, with Runway Visual Range reported at 3,000 ft., a B737 captain - just after touch down - observed the amber rotating beacon on a vehicle about 1,000 ft. ahead on the runway. The captain made an immediate "go-around" and missed the eight vehicles by an estimated 10 feet. (NTSB Report Number CHI84IA127) What happened? While the aircraft was about 15 miles SW of the airport and being vectored for a runway 36 Cat II approach, the local controller had given the ground controller permission to clear snow removal equipment to proceed north on runway 36 and to exit runway 36 at the intersection of Runway 27L. The aircraft reported at the outer marker and was cleared to land with no further conversation between controllers about the status of the snow removal equipment.

Many controller operational errors and pilot deviations could have been prevented with a question or "heads-up" call from another pilot. The airport surface is NOT the place to "mind your own business." Consider the following excerpts from incident reports:

- "In one near-collision, a controller cleared an aircraft to land and - seven seconds later instructed another aircraft to taxi into position and hold on the same runway. Neither air craft "heard" the other aircraft's clearance, nor were they advised of the other aircraft's position. The supervisor noticed the potential conflict and alerted the controller. Unfortunately, the controller issued a go-around instruction using the wrong call sign. The aircraft overflew the other aircraft by about 35 feet before touching down."
- "It would have been helpful if one of the six aircraft that were instructed to cross (the runway) had heard the clearance given to aircraft X "cleared for take-off" and questioned the controller."
- In at least one incident (NTSB report number NYC87IA202), an aircraft was cleared to cross an active runway but notified the tower that it would hold short when the pilots saw the B767 landing lights on final approach.

Know what runways are between where you are and where you <u>are going</u>. Listen up for all clearances involving "your" runway and any crossing runways. Question anything that makes you nervous.

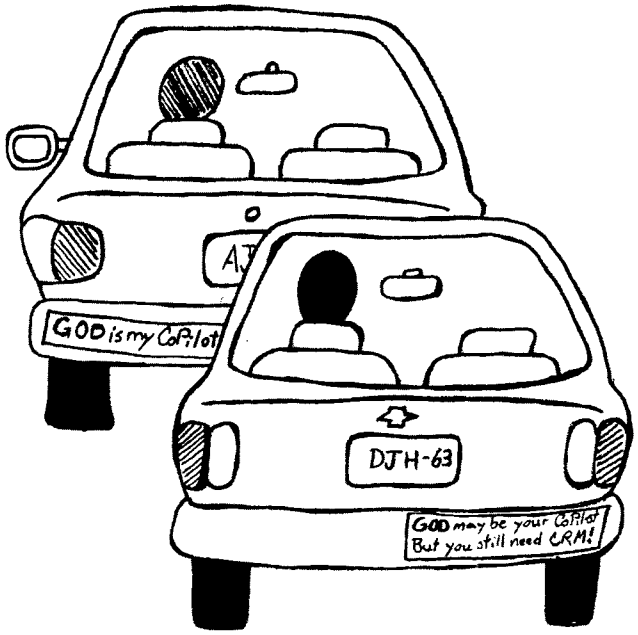
You might think that losing sight of a big plane in Visual Meteorological Conditions (VMC) during the day would be about as easy as losing an elephant in a taxi cab, However, converging runways and taxiways present special challenges to pilots as well as controllers. Consider this:

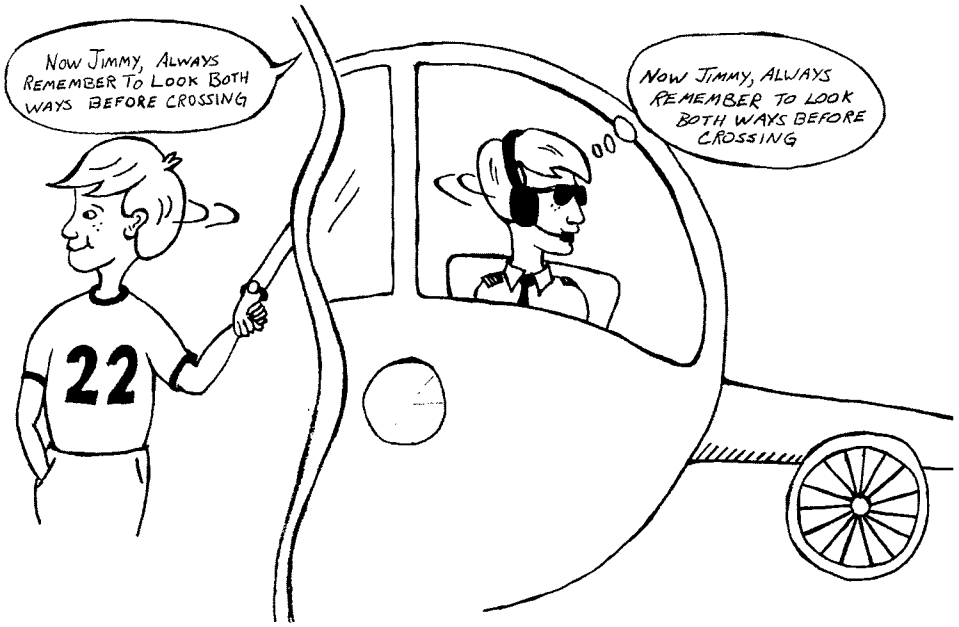
> On July 28, 1995 a Cessna 401 was cleared to taxi from the ramp to the runway and was advised of the "Boeing clearing that runway." The Cessna advised having the aircraft in sight and taxied from the ramp to taxiway Bravo. XXX had been cleared for takeoff and reported having the Boeing 737 in sight. After turning onto taxiway Bravo, the captain lost sight of the 737 as the first officer was "occupied with duties inside the cockpit and did not see the 737 until immediately before the collision." The collision occurred as the 737 merged from Mike onto Bravo. The 737 crew said they never saw the Cessna.. " According to witnesses, the two aircraft were moving in the same direction at the same speed on the converging taxiways. The left wing of the 737 impacted the rudder of the Cessna as the 737 merged from Mike onto Bravo. (NTSB Report Number FTW95FA319A)

In another incident, a Boeing 747 was being taxied for departure at night when its left wing collided with the right wing of a Boeing 767 being towed in the same direction on a parallel taxiway. (NTSB report LAX85IA037)

Many a disoriented pilot has crossed a runway without a clearance and, in some cases, crossed in front of an aircraft taking off. In other instances, a controller mistakenly cleared an aircraft for take-off or to cross an active runway and later wished they hadn't. ALWAYS scan the runway and approach areas before taking or crossing a runway.

Both heads should be on the taxi route and out the window until clear of all runways.



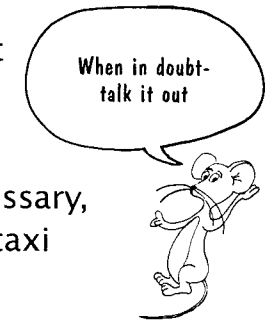


Chapter 4

Surveillance - The Art of "See and Avoid" – or "Seek and Ye Might Be Surprised What Ye Might Find"

Make surface operations a WIN/WIN situation.

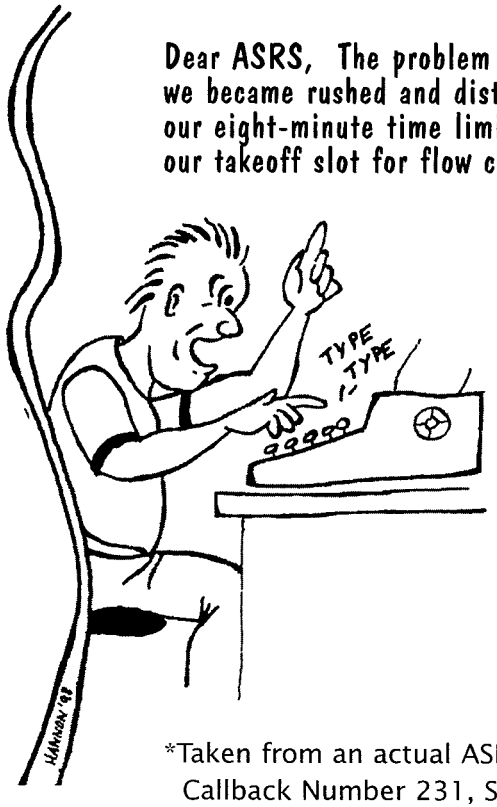
When in doubt about a clearance – ASK. Take the question out of the cockpit right to the controller. A few extra seconds on the frequency is preferable to hearing "possible pilot deviation."



If you're uncertain about your location on the airport – STOP and ASK. If necessary, tell the controller you're unfamiliar with the airport and ask for progressive taxi instructions. Pride is a lot easier to swallow than a runway incursion.

> "The Captain of the DC-9 questioned his position a full 53 seconds before the collision: however, neither he nor the first officer advised the ground controller of their uncertainty at that time. If they had done so, the local controller might have taken action to prevent the B-727 takeoff." (NTSB report number NTSB/AAR-91/05)

NEVER stop on a runway. Make every effort to clear the runway as quickly as possible and wait for taxi instructions.



*Taken from an actual ASRS report in Callback Number 231, September 1998

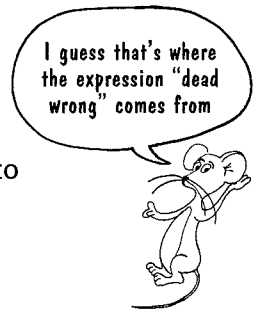
Don't Rush It - No matter what we're doing, there is a "speed/ accuracy trade-off." That means the faster we try to do something, the more mistakes we typically make. Take the time to give critical tasks the time they deserve.

Clear the runway as soon as possible, but not by turning onto another runway, unless specifically instructed to do so. Also, never back-taxi down a runway unless specifically cleared to do so.

OBEY POSTED SPEED LIMITS – OK, so there aren't speed limit signs on taxiways, but defensive taxiing does NOT involve speeding down taxiways or through taxiway and runway intersections. The higher the ground speed, the less time you have to react, maneuver the plane, and avoid an obstacle, AND the more space you need to bring the plane to a...

Before take-off and after landing - **TAXI DEFENSIVELY** - that is, be prepared for other pilots' mistakes. This is especially important at uncontrolled fields. Consider this:

"Due to a mechanical problem, our flight (Air Carrier X) departed after the Tower had closed for the night. We complied with our company's "non-Tower" procedures found on our commercial chart page. The First Officer called Center prior to taxi for our clearance using VHF#2 radio. The First Officer then made a "taxi to Runway 09" call on the CTAF using the VHF#1 radio. Upon reaching the end of Runway 09, the First Officer called "taking the active" on CTAF. As we lined up, we heard Air Carrier Y announce his taxiing on the CTAF. The First Officer then called "beginning takeoff roll" on CTAF and Center's frequency. I transferred aircraft control to the First Officer and we began rolling between 80-100 knots. We heard Air Carrier Y announce his intentions for an intersection takeoff (Taxiway A) on Runway 27. The First Officer and I both had the Air Carrier Y in sight, and as we neared V_1 (rotate speed) we saw that he was not going to stop prior to entering the runway. The First Officer expedited rotation and we went over Air Carrier Y by approximately 300 feet as he entered the runway. During this time, I tried contacting Air Carrier Y on CTAF, but he did not respond.... Air Carrier Y said something about the volume on his radios and that 'he guesses he's just used to having the airport to himself at that time of night'."
(ASRS Callback Number 253 September 2000)



With airport construction or any other unusual activity, extra caution is required from both pilots and controllers. Even a familiar airport can become an unfamiliar maze with construction.

A B737 Captain became disoriented in daylight VMC at an airport he's flown in and out of for many years and inadvertently re-entered the runway he had just landed on. He immediately realized his mistake and executed a 180 degree turn and exited the runway, but not before a DC-10 started its takeoff roll. The DC-10 rotated and crossed over the B737 by about 200 ft. How can this happen? First, the Captain reported that the heavy construction at the terminal area led him to become disoriented. To make matters worse, the runway sign was not visible, because it had blown over. The First Officer stated that while the Captain was taxiing the aircraft, he was busy completing the after landing checklist. (NTSB Report Number LAX88IA064)

When it comes to surface radar at airports, there are the "have and have nots" - and the list of airports that do NOT have surface radar may surprise you. (There is a list of airports with the latest Airport Surface Detection Equipment [ASDE-3] in the appendix of this document.) Never assume that the controller can see you on radar while you're on the ground. Always call the tower if you have any doubts about where you are or where you should be.

The 3 Rs for preventing surprises that can lead to a runway incursion:

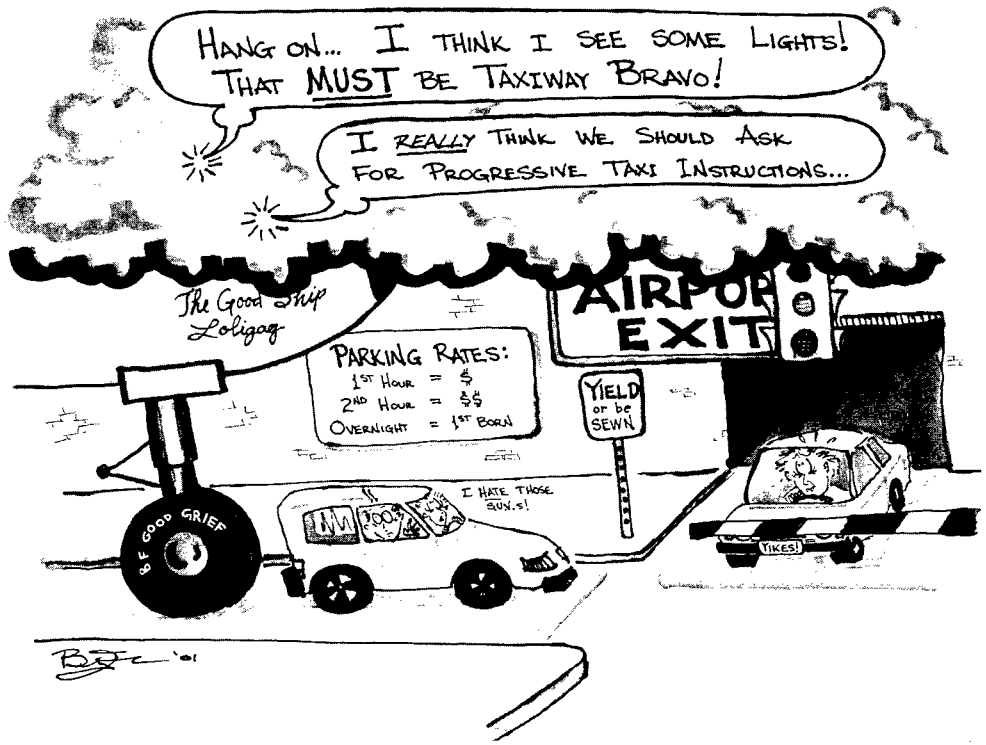
Review NOTAMs for runway/taxiway closures and construction.

Refer to the airport layout as aprt of the ground movement briefing prior to gate departure and descent for landing.

Readback all runway crossing and/or hold short instructions with your call sign and the runway designator.

Use the heading display or compass to confirm runway alignment – particularly at complex intersections.

- If ATC requests you to maneuver around another aircraft, remember that YOU are the only one who can really judge as to whether or not it is possible or wise – when in doubt, call ATC and suggest an alternative.



Chapter 3

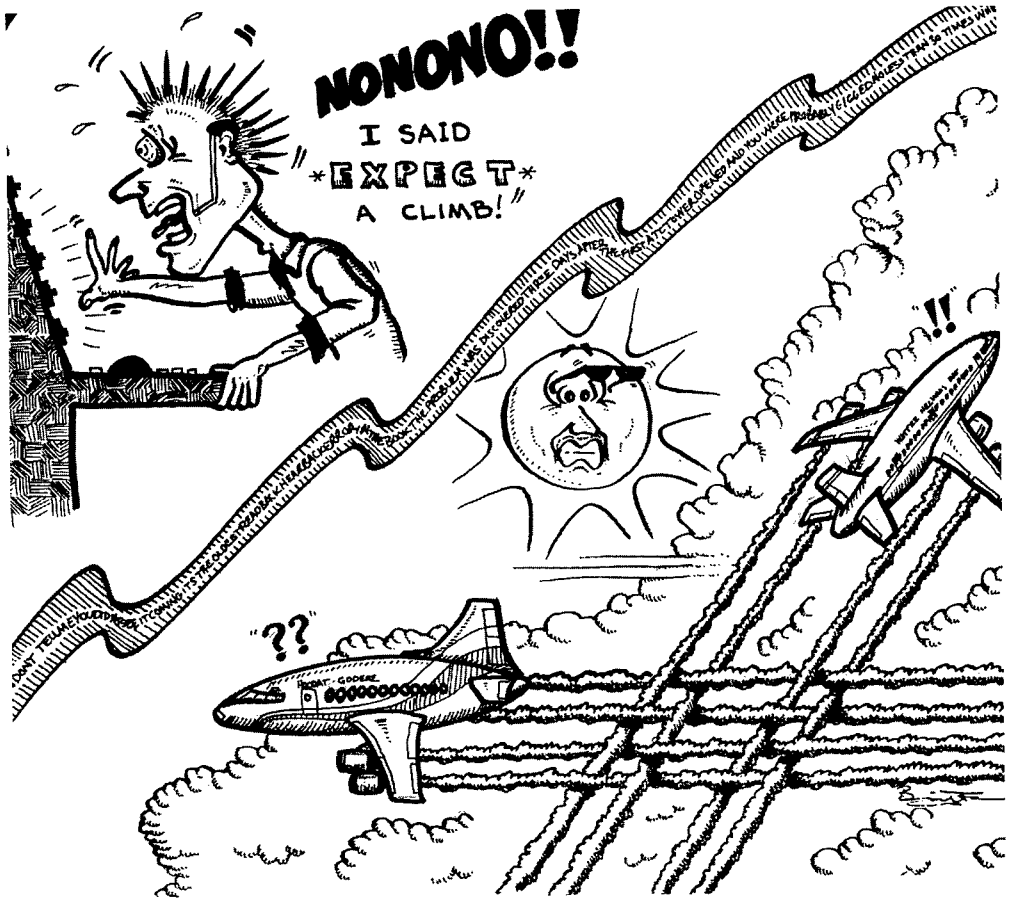
Navigation - How to Get to Where You Should Be

Many pilot deviations have been caused by pilots following a clearance they were only told to "expect" - either by interpreting it as a clearance, or by failing to notice the differences between the actual clearance and what they had been told to expect. In fact, a study of Aviation Safety Reporting System (ASRS) reports found that 33% of the communication errors between the cockpit and ATC that resulted in runway transgressions identified pilot expectations as contributing to the error.[2]

> In one close call, a B-727 was told to expect to land on Runway 4L but later cleared to land on 4R. The pilot did not readback the clearance, nor did the controller request it. The aircraft landed on 4L while another B-727 was holding in position on the displaced threshold. The crew of the landing aircraft did not see the holding aircraft until they were almost over it. This incident occurred at night and the only lights on the holding aircraft were the navigation lights, taxi light and rotating beacon. (NTSB Report Number NYC93IA065)

Did you know it takes about twice as much information to "debunk" a wrong conclusion as it does to form a conclusion to begin with? Once we think we have "the picture," we tend to take in information that confirms our thoughts, and ignore information to the contrary. This makes it difficult to realize, for example that we're really crossing runway 23, when we expect to cross runway 14.

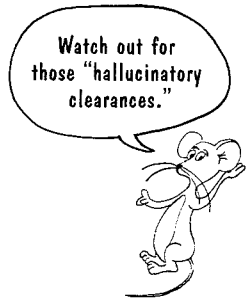
Controllers know that telling you what to expect can help you plan more effectively. However, expectations are a double-edge sword. When our expectation is correct, our information processing is faster and more accurate (than if we had no expectation). However, if the expectation is wrong, we're primed for mistakes. We are all set up to hear what we expect - and want - to hear. That's one reason why both pilots should be "listening up" for clearances to taxi, take-off, and land - calling special attention to any differences between the actual clearance and what you were told to expect.

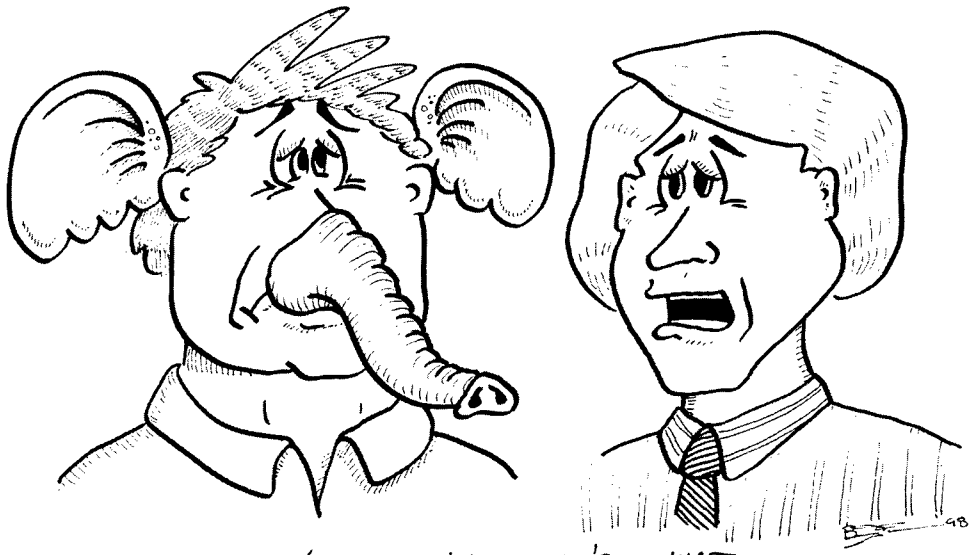


Stress impairs memory and makes it easier to forget things.

Learn to recognize your own personal signs of stress and those of your colleagues. This may include talking too fast, too loud, and/or in a higher pitch, sweating, increased heart rate, and moving close to the windscreen. While a little stress can energize you, a little more can lead to mistakes. Stress is a little like the weather, we can't control it, but we can be prepared for it and learn to deal with it. When the going gets tough, take time to mentally step back and assess the situation.

Memory is also "constructive," that is, we have a tendency to "fill in the blanks." More than one pilot has taken off without a clearance after receiving an instruction like "fly heading 310 on departure."





Chapter 2

An Elephant Might Never Forget, but We're not that Lucky: How to Make the Most of the Memory you Have

Human memory is unreliable and needs all the help it can get. Observe the memory-joggers used by other pilots and use what works for you. "Working" with specific information will help you to remember it. Even the simple acts of repeating the information (preferably to your crewmember) or writing it down* will help you to remember it.

Be prepared to write down taxi instructions – especially at complex or unfamiliar airports – and cross-check the instructions against the airport diagram.

Translation, please. ICAO phraseology used in other countries and its US equivalent.

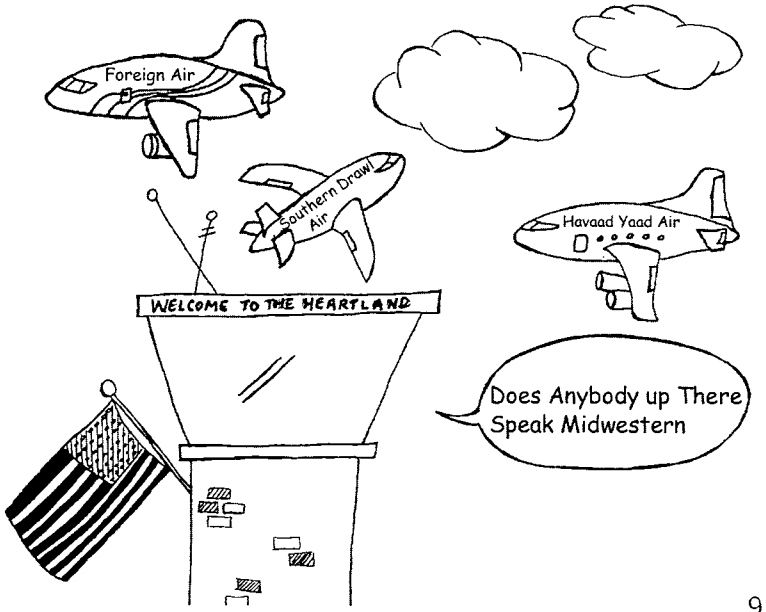
"Line up and wait"

"Hold in position"

"Position and hold"

"Hold" [as in stay put]

Speaking slowly and distinctly gives any listener a better chance of hearing what you said. However, it is especially important to speak S-L-O-W-L-Y and DISTINCTLY when talking to foreign controllers. As we speed up our speech rate, we lose many of the cues that help us tell the difference between certain speech sounds. For non-native listeners, those cues can mean the difference between understanding your transmission or not.



A first officer who did "not believe in readbacks of clearances, as that tends to clutter the frequency," responded "Roger" to a clearance to "position and hold" that was intended for another aircraft. This runway transgression necessitated a go-around for an incoming aircraft. (ASRS Accession Number 217581)

And if you think THAT was tough...

Flying internationally has special challenges. Reports submitted to ASRS on events at foreign airports caused by confusion stemming from language and phraseology differences range from amusing [as in "Would you like to orbit the airport?" – translation, "I think you'd better go around."] to downright dangerous. The most common problem is based on the fundamental difference between the U.S. "position and hold" [i.e., go onto the runway] and standard ICAO phraseology "hold in position" [i.e., stop]. There have been several incidents attributable to this and similiar differences in phraseology. Consider the following report submitted to ASRS:

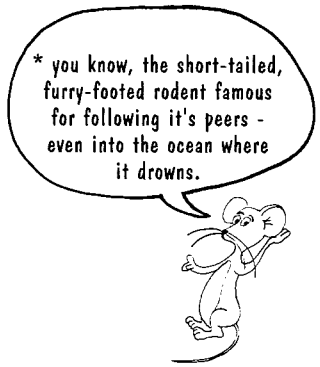
> During taxi, tower issued instructions in a very heavy [European] accent that sounded like, "Cleared into position and wait." The First Officer, employing a phraseology that is common in the U.S., asked in a very clear and enunciated fashion, "Did you clear us into position and hold?" The tower's answer was "yes." I proceeded beyond the ILS [critical area] hold line. The tower shouted "STOP!" We spotted an airliner breaking out of the clouds. Although we never penetrated the area of the runway, the sudden stop, the proximity to the runway, and the sight and sound of the landing aircraft scared all of us....Perhaps if we had asked him, "Do you want us on the runway?", he would have responded with a strong, "No!"
>
> Callback Number 209, November 1996, Aviation Safety Reporting System

Communications –

- Use standard ATC phraseology. (Note: "on the hold" and "on position" are not standard phraseology.)
- Readback all clearances to takeoff, land, cross, and hold short of the active runway with your call sign and the runway designator.
- When instructed to "take the next exit" after landing, or to "land and hold short of...," you should *immediately* respond "unable" if there is any doubt that you will be able to make it.
- When acknowledging taxi instructions after landing, do so while at taxi speed. Rollout first, then pick up the mike.
- If you need to go off the ATC frequency, notify your crewmember and have the other pilot brief you on what you missed (if solo, notify ATC) and NEVER go off ATC frequency until you're clear of all runways.
- Instruct jumpseat passengers to watch for traffic, and monitor ATC and tell you about any missed calls or possible readback errors.

Pilots need to be particularly attentive when there is an aircraft with a similar call sign on the frequency. Having an aircraft with a similar call sign on the same frequency is the number one factor contributing to aircraft accepting another aircraft's clearance.[2] In a study of pilot reports of surface incidents to ASRS, one-third of them involved communication errors between pilots and controllers. Sixteen percent of these communication errors involved pilots accepting another aircraft's clearance; in each of these instances, the two aircraft had similar call signs.[3]

When issued a clearance that contains the word "Follow" – Don't be a victim of the "lemming* syndrome."[4] If told to "follow" another aircraft, make sure you and the controller have a common understanding of the taxi clearance limit. If necessary ask what the limit is. Remember, any instruction to "follow" another aircraft does NOT imply a clearance to cross - or take - an active runway.



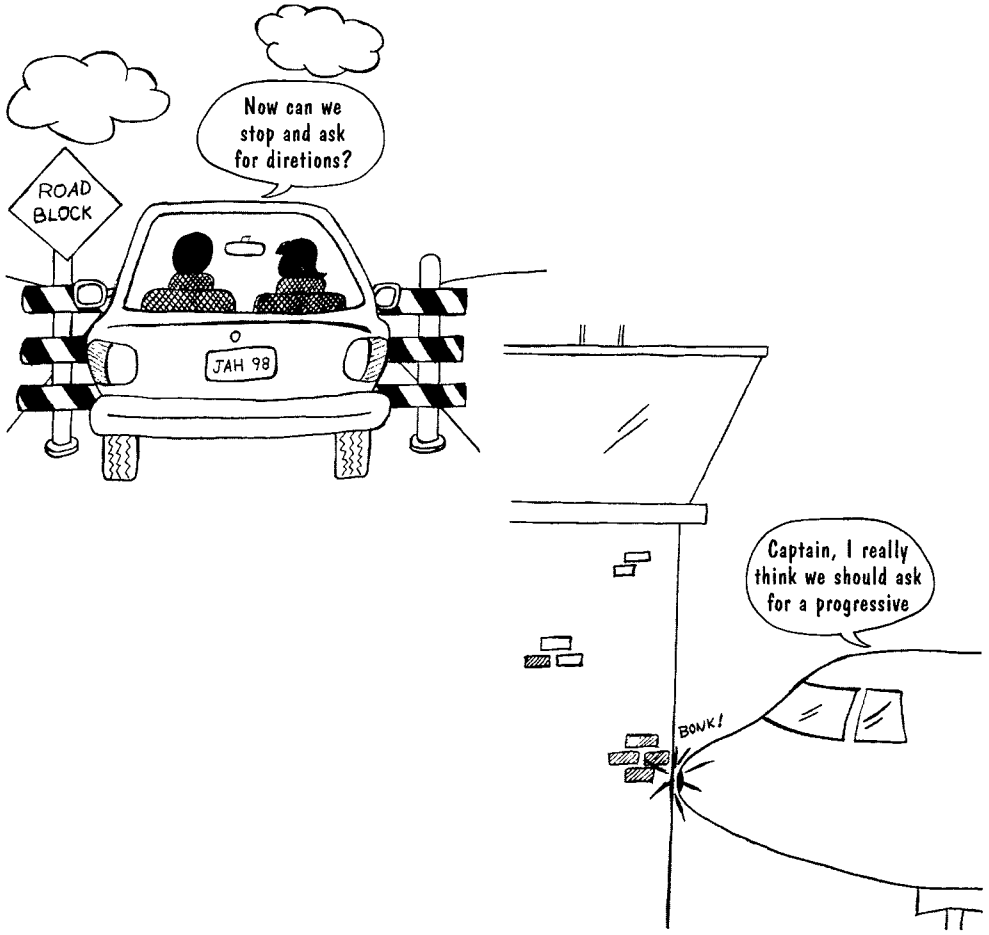
Controllers often issue clearances to "position and hold" on the runway. Holding in position for a few seconds before being cleared for take-off can help traffic move expeditiously. Logically, however, you are a "sitting duck" in this position. Controllers can get distracted and forget about an aircraft that is holding at the end of the runway and clear another aircraft to land on the same runway. If the controller tells you to "position and hold, expect delay," ask for the expected holding time. Do whatever you can to increase your awareness of the traffic situation. If possible, use your cockpit traffic display to look for aircraft on approach. Above all, LISTEN UP and if you think the controller forgot about you – or if you've been holding for more than a minute – ASK.

ABCs of Surface Communications:

Acknowledge all clearances to take-off, land, cross or hold-short with your callsign and the runway designator.

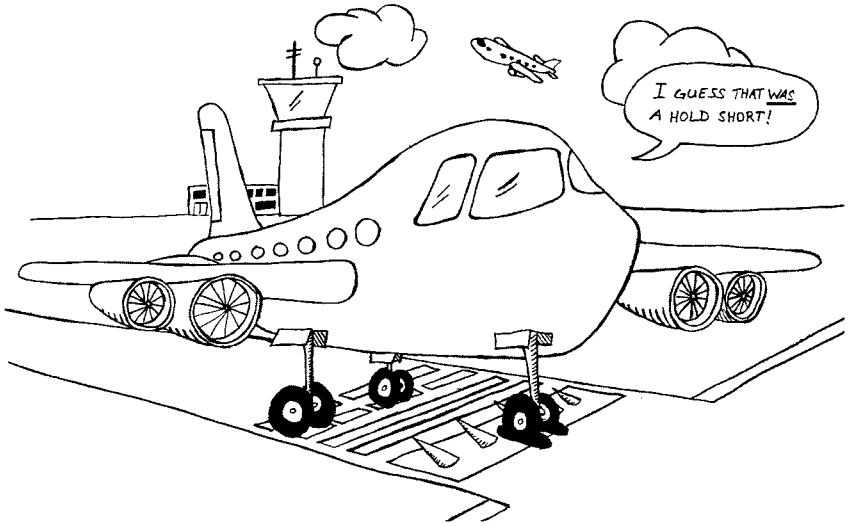
Both pilots should monitor for clearance to taxi, take-off, and land with the airport diagram displayed.

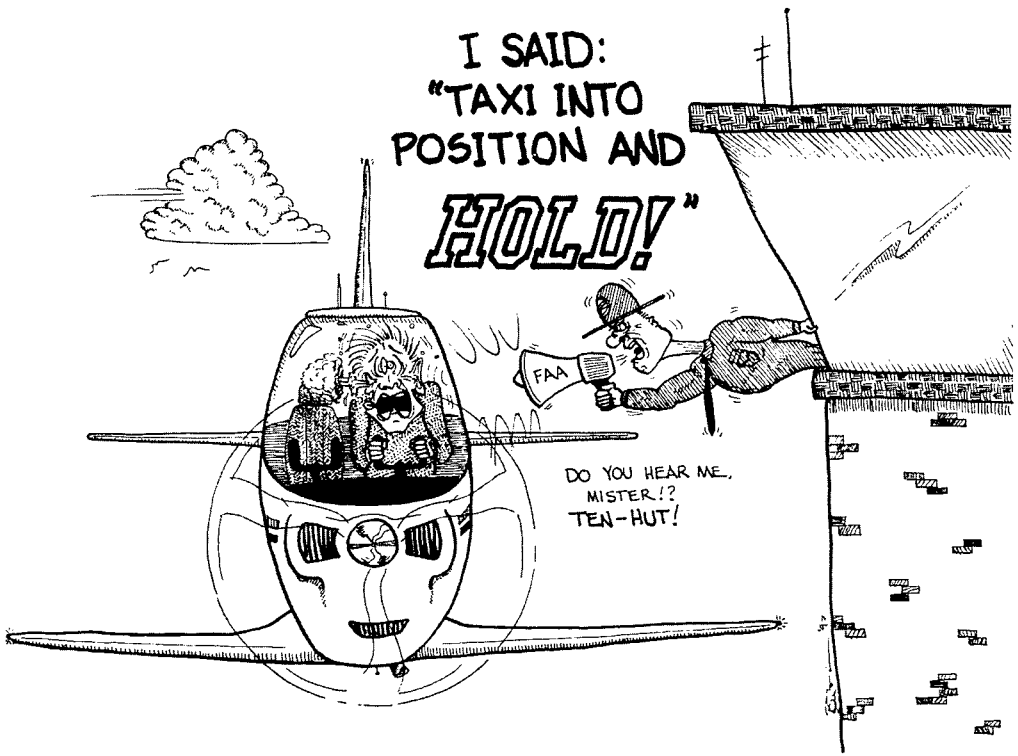
Clear up any uncertainties about your clearance or your position on the airport surface.



Serious runway incursions are rarely simple, they are often due to a combination of factors or a "snowballing" effect. Communication – or miscommunication – is very often part of the equation.

The controller instructed a foreign pilot to taxi via Juliet and "hold short of 22R." The pilot readback (with a heavy accent) "OK, straight ahead on Juliet and no hold short on 22R." The use of non-standard phraseology – "no hold short" rather than "cross runway" - was an unwitting "set up" for the controller. Hearing what he expected to hear – "hold short" – he didn't hear the "no" and expected the pilot to hold. To further complicate the situation, although visibility was 1/4 mile, the intersection of Runway 22R and Juliet was not visible from the tower. The errant aircraft crossed the runway as another aircraft was departing on the same runway.





Chapter 1

Pilot-Controller Communications or "Was that for us???"

U.S. Department
of Transportation
Federal Aviation Administration

Memorandum

Subject: Runway Safety

Date: NOV 27 2001

From: Chief Scientific and Technical Advisor for Human Factors, AAR-100

Reply to Attn. of: Paul Krois, x35310

To: Distribution

The identification and mitigation of the causal factors of runway incursions is an effort critical to the Federal Aviation Administration. The development of *Runway Safety: It's Everybody's Business* was sponsored by the Office of Runway Safety and provides helpful information on memory, pilot/controller communication, and situation awareness. We are proud to make this booklet available to Air Traffic Control Specialists and pilots around the world.

I want to thank the National Air Traffic Controllers Association and the Air Transport Association for its assistance in distributing this booklet to their members.

Mark D. Rodgers, Ph.D.